Attachment 2 to the Performance Work Statement

NHSRC's Quality System Specifications for Extramural Actions –

These requirements typically pertain to single project efforts. The five specifications are:

(1) a description of the organization's Quality System (QS) and information regarding how this QS is documented, communicated and implemented;

(2) an organizational chart showing the position of the QA function;

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(4) the background and experience of the QA personnel who will be assigned to the project; and

(5) the organization's general approach for accomplishing the QA specifications in the SOW.

NHSRC QA Requirements/Definitions List

Category Level Designations (determines the level of QA required):

☐ **Category A Project (formerly Category 1 and 2)** – applies to research that is anticipated to result in high-visibility products. In this case, the QAPP shall address all elements listed in "EPA Requirements for QA Project Plans, EPA QA/R-5. **http://www.epa.gov/quality/qs-docs/r5-final.pdf**

Research of this nature meets one or more of the following criteria:

- Results are ISI
- Has a high probability the results could be used in litigation or enforcement
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- Direct regulatory support

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Additional information regarding QAPP requirements for a specific project type are provided below.

Project Types:

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☐ **Method Development Project** - pertains to situations where there is no existing standard method, or a standard method needs to be significantly modified for a specific application.

For other types of project types, the EPA Guidance documents are available. All QAPPs must conform to applicable sections of R-5 in a way that fully describes the research plan and appropriate QA and QC measures to ensure that the data are of adequate quality and quantity to fit their intended purpose. The specific and general guidance documents can be found at http://www.epa.gov/quality/qa_docs.html#guidance

☐ **Design, Construction, and/or Operation of Environmental Technology Project** - pertains to environmental technology designed, constructed and/or operated by and/or for EPA. The QAPP shall address requirements in the EPA Quality System document "Guidance on Quality Assurance for Environmental Technology Design, Construction, and Operation" (EPA QA/G-11)

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Definitions:

Environmental Data - These are any measurement or information that describe environmental processes, location, or conditions; ecological or health effects directly from measurements, produced from software and models, and compiled from other sources such as data bases or the literature. For EPA, environmental data include information collected directly from measurements, produced from software and models, and compiled from other sources such as data bases or literature.

Incremental Funding - Incremental funding is partial funding, no new work.

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Quality Assurance Project Plan (QAPP) - A QAPP is a document that describes the necessary quality assurance, quality control, and other technical activities that must be implemented to ensure that the results of the work performed will satisfy the stated performance criteria. A QAPP documents project-specific information.

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Quality Management Plan (QMP) - A QMP is a document that describes an organization's/program's quality system in terms of the organizational structure, policy and procedures, functional responsibilities of management and staff, lines of authority, and required interfaces for those planning, implementing, documenting, and assessing all activities conducted. A QMP documents the overall organization/program, and is primarily applicable to multi-year, multi-project efforts. An organization's/program's QMP shall address all elements listed in the "Requirements for Quality Management Plans" in Appendix B of the NHSRC QMP.

Quality System - A quality system is the means by which an organization manages its quality aspects in a systematic, organized manner and provides a framework for planning, implementing, and assessing work performed by an organization and for carrying out required quality assurance and quality control activities.

R-2. EPA Requirements for Quality Management Plans (EPA/240/B-01/002) March, 2001 http://www.epa.gov/quality/qs-docs/r2-final.pdf

R-5. EPA Requirements for Quality Management Plans (EPA/240/B-01/002) March, 2001 http://www.epa.gov/quality/qs-docs/r5-final.pdf

Substantive Change - Substantive change is any change in an activity that may alter the quality of data being used, generated, or gathered.

Principal Investigator (PI) - This person is technically responsible for the project. For extramural contract work, the PI is typically the contracting officer's representative (COR). For intramural work, the lead researcher is typically the Principal Investigator.

Abbreviations:

COR - Contracting Officer's Representative
NHSRC - National Homeland Security Research Center
QA ID Quality Assurance Identification
QAPP Quality Assurance Project
Plan QS – quality system
PI - Principal Investigator

EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 4-096

☐ Other ☐ Amendment Number:

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-15-008	04/01/2015 To 03/31/2020 Base Option Period Number 4	See attached PWS

Contractor: JACOBS TECHNOLOGY INC.

Specify Section and paragraph of Contract SOW: Section 2.0

Purpose:
- [X] Work Assignment
- [ ] Work Assignment Amendment
- [ ] Work Plan Approval
- [ ] Work Assignment Close-Out
- [ ] Incremental Funding

Period of Performance: From 04/01/2019 To 03/31/2020

Comments:

Work Plan due 4/29/19.

No work, including but not limited to preparation of the Work Plan, shall begin until 4/1/19.

☐ Superfund — Accounting and Appropriations Data — [X] Non-Superfund

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

SFO (*Max 2*) ☐

Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code
1										
2										
3										
4										
5										

Authorized Work Assignment Ceiling

	Cost/Fee	LOE
Contract Period: 04/01/2015 To 03/31/2020		
This Action:		
Total:		

Work Plan / Cost Estimate Approvals

	Cost/Fee	LOE
Contractor WP Dated:		
Cumulative Approved:		

Work Assignment Manager Name: Joe Wood (Signature) (Date)	Branch/Mail Code: Phone Number: 919-541-5029 FAX Number: 919-541-0496
Project Officer Name: Robin S. Harris (Signature) (Date)	Branch/Mail Code: Phone Number: 919-541-0955 FAX Number:
Other Agency Official Name: (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:
Contracting Official Name: Keith Pfeffer (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:

Performance Work Statement

WA Title: Evaluating Material Compatibility with Decontaminants
Work Assignment: 4-096
WACOR: Joseph Wood
Alternate WACOR: Shannon Serre
CONTRACT:
EP-C-15-008
Project# HS8.67.06-2208

PERIOD OF PERFORMANCE

The period of performance detailed in this Performance Work Statement (PWS) shall be from April 1, 2019 through March 31, 2020.

SUMMARY OF OBJECTIVES

The purpose of the study is to continue monitoring impacts on materials that were exposed to fogging and other decontaminants in the previous WA 3-096.

BACKGROUND

Following a bioterrorist attack, materials may be decontaminated with PAA fog, low concentration hydrogen peroxide vapor (LCHP), or other techniques. This study will investigate impacts to a wide range of materials following such fogging or use of LCHP. The EPA's NHSRC conducts research to develop methods and technologies to rapidly and cost-effectively remediate areas affected by a bioterrorism attack. Tasks performed under this work assignment support such research.

SCOPE

The results of the work conducted under this WA study will provide data and information on the material compatibility of these types of technologies on a wide-ranging array of materials. The results of this work will be made available through a published report, and possibly a conference abstract and presentation.

TECHNICAL APPROACH/OBJECTIVES

Testing shall be conducted using the procedures, and according to the Quality Assurance Project Plan (QAPP) and its amendments, developed under WA 2-077 and WA 3-096 of this contract. No tasks conducted under this WA shall be repeated from WA 2-077 or 3-096.

The contactor shall perform the following tasks:

Task 1. Quality Assurance Project Plan (QAPP)

No new work related to the QAPP development or amendments shall be conducted under this WA. The QAPP and amendments were prepared under previous WAs under this contract. All work described below shall be conducted according to the QAPP and amendments.

Attachment 1 to this PWS provides information regarding NHSRC QA Requirements/Definitions List. QAPPs prepared for a Category B (formerly known as a Category 3 or 4) project shall be developed in accordance with the document titled "EPA Requirements for Quality Assurance Project Plans." EPA QA/R-5 can be found at http://www.epa.gov/quality/qs-docs/r5-final.pdf and shall be approved by an EPA Quality

Assurance Manager (QAM) prior to the start of any literature searches (existing data), data collection, gathering, synthesizing, or data generation (laboratory) work. At the discretion of the WACOR, a Category B QAPP may be based on the R5 guidance (described above) or a NHSRC project-specific QA requirements template provided as Attachment 2. Additional information related to QA requirements can be found at www.epa.gov/quality.

Task 2. Continue to assess functionality and compatibility of materials
The contractor shall conduct compatibility and functionality testing according to the modified QAPP discussed under Task 1 and per the following requirements:

A. Continue to assess compatibility and functionality for each set of materials and equipment that were exposed to peracetic acid fog, or both tests with LCHP, in previous WA. Use methods established in QAPP and in accordance with previous WA. The schedule/frequency of these assessments shall be consistent with QAPP and may be monthly. These tests shall be conducted until 12 months of compatibility testing has been conducted, or within the performance period constraints for this Option Period.

Task 3. Provide general support for maintaining the lab equipment
This support shall include assembly, maintenance, troubleshooting, and configuration support for any equipment used for testing. Support shall also include the purchase of any expendable materials, with prior approval from the WACOR, for use in this project.

Task 4. Report the results of all tests to the WACOR as soon as possible
Report the results of the initial fog test to the WACOR within 7 days, via email and through the use of the DTRL share drive. Also report the results of each material compatibility test (Task 2D) to the WACOR within 7 days. The WACOR shall be notified immediately of any problems encountered in the laboratory or with the results obtained. These data shall include data from biolab, any generated data files (i.e., logged data) properly annotated, reports of the experimental conditions, calibration checks, measured variables, and a listing of the samples awaiting further analysis.

Task 5. Meet with the WACOR
Meet with the WACOR at least every week to provide a project status update. The update shall include a synopsis of activities taking place the past week, problems encountered, and work planned for the next week.

Task 6. Prepare monthly reports
Prepare monthly reports to EPA that summarize work activities (accomplished and planned) in this work assignment, including the status of applicable test, QA, and safety plans. The monthly report shall also detail labor costs and ODC charges. The ODC charges shall be documented in the report in a way that the items purchased, vendor, and cost are clearly indicated.

Task 7. Prepare test report.

Prepare a draft test report, and based on comments received from the WACOR, revise the report to produce a final test report. The scope of the report shall be similar to previous EPA published reports. Alternatively, a draft journal article may be prepared.

Task 8. Update the health and safety protocols

Update the health and safety research protocols, as needed, as required by the EPA Facility and APPCD safety personnel. Updates to these protocols shall be approved by the EPA WACOR and safety personnel prior to the commencement of any testing. The contractor shall provide a copy of the health and safety plan to the WACOR and the ORD-Safety Office for discussion.

INSTRUMENTATION/EQUIPMENT EXPECTATIONS

All tasks described in this PWS shall be performed in-house, at the EPA's Research Triangle Park (RTP) facilities.

DELIVERABLES

Data Delivery

Raw data from the biolab (e.g., plate counts, qualitative growth results, etc.) shall be emailed to the WACOR, and by carbon copy (cc) to the WACOR of the project the microbiology lab is supporting, as soon as the data become available (not greater than 2 working days after completion of the analysis generating the data).

Reporting

The reports shall be prepared specifying the following: (1) summary of work conducted during the preceding months, including tables and/or charts using MS EXCEL format, as appropriate, with sufficient annotation as deemed adequate by the EPA WACOR, (2) analyses of the work in accordance to the expectations specified by the QAPP of each project, (3) progress on each task and the reason for any deviations from the project schedule, (4) work anticipated during the coming quarter. These reports shall be submitted electronically near the end of each quarter. Additionally, pdf copies of the laboratory notebook, including the pages documenting activities performed during the period, shall be created and delivered electronically to the WACOR the same day the quarterly report is delivered.

SCHEDULE OF DELIVERABLES

The following table outlines the schedule that the contractor shall meet for the period covered by this PWS. Dates dependent upon completion of specific tasks shall be updated based on discussions between the contractor and EPA WACOR during the development of the test plans to cover the work specified herein.

Deliverable Schedule

Deliverable	**Completion Date**
Submit Work Plan	In accordance with WA cover page

Complete material compatibility/functionality tests described in Task 2.	2/28/20
Submit draft test report or journal article for review by WACOR	3/8/20

Attachment 1 to the Performance Work Statement

NHSRC QA Requirements/Definitions List

EPA=s Quality System Website: http://www.epa.gov/quality

In accordance with EPA CIO 2105.0 (Order), EPA 2105-P-01-0 (Manual), and conformance to ANSI/ASQC E4 must be demonstrated by submitting the quality documentation described herein. All Quality documentation shall be submitted to the Government for review. The Government will review and return the quality documentation, with comments, and indicate approval or disapproval. If the quality documentation is not approved, it must be revised to address all comments and shall be resubmitted to the Government for approval. Work involving environmental data collection, generation, use, or reporting shall not commence until the Government has approve the quality documentation. The Quality Assurance Project Plan (QAPP) shall be submitted to the Government at least thirty (30) days prior to the beginning of any environmental data gathering or generation activity in order to allow sufficient time for review and revisions to be completed. After the Government has approved the quality documentation, the Performer shall also implement it as written and approved by the Government.

Attachment 2 to the Performance Work Statement

NHSRC's Quality System Specifications for Extramural Actions –

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(1) a description of the organization's Quality System (QS) and information regarding how this QS is documented, communicated and implemented;

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http://www.epa.gov/quality/qs-docs/r2-final.pdf

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QAPP Quality Assurance Project Plan
QS – quality system
PI - Principal Investigator

EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 4-097

☐ Other ☐ Amendment Number:

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-15-008	04/01/2015 To 03/31/2020 Base Option Period Number 4	See attached PWS

Contractor: JACOBS TECHNOLOGY INC.

Specify Section and paragraph of Contract SOW: Section 2.0

Purpose:
- [X] Work Assignment
- [ ] Work Assignment Amendment
- [ ] Work Plan Approval
- [ ] Work Assignment Close-Out
- [ ] Incremental Funding

Period of Performance: From 04/01/2019 To 03/31/2020

Comments:

Work Plan due 4/29/19.

No work, including but not limited to preparation of the Work Plan, shall begin until 4/1/19.

☐ Superfund — Accounting and Appropriations Data — [X] Non-Superfund

SFO (*Max 2*) ☐

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code
1										
2										
3										
4										
5										

Authorized Work Assignment Ceiling

	Cost/Fee	LOE
Contract Period: 04/01/2015 To 03/31/2020		
This Action:		
Total:		

Work Plan / Cost Estimate Approvals

	Cost/Fee	LOE
Contractor WP Dated:		
Cumulative Approved:		

Work Assignment Manager Name: Lukas Oudejans (Signature) (Date)	Branch/Mail Code: Phone Number: 919-541-2973 FAX Number:
Project Officer Name: Robin S. Harris (Signature) (Date)	Branch/Mail Code: Phone Number: 919-541-0955 FAX Number:
Other Agency Official Name (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:
Contracting Official Name: Keith Pfeffer (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:

Performance Work Statement

WA Title: Development of Fentanyl Cleanup Approaches for State and Local Responders

WA #: 4-097 WACOR: Lukas Oudejans

Contract #: EP-C-15-008 Alternate WACOR: Anne Mikelonis

PERIOD OF PERFORMANCE

The period of performance detailed in this Performance Work Statement (PWS) shall be from April 1, 2019 through March 31, 2020.

This WA is a direct continuation of research initiated under WA 3-097.

SUMMARY OF OBJECTIVES

To assess volumetric decontamination approaches for indoor environments that are contaminated with the synthetic opioid fentanyl. This will be accomplished in a phased approach that includes bench scale testing followed by pilot scale testing of successful remediation approaches. The last objective is to demonstrate remediation approaches to stakeholders using a mock setup.

BACKGROUND

EPA is designated a coordinating Agency, under the National Response Framework, to prepare for, respond to, and recover from a threat to public health, welfare, or the environment caused by actual or potential oil and hazardous materials incidents. Hazardous materials include chemical, biological, and radiological substances, whether accidentally or intentionally released.

The imminent threat of a chemical agent release into the environment is driving the US EPA's Homeland Security Research Program (HSRP) to systematically evaluate potential decontamination technologies for chemical agents. The recent increases in fentanyl-related unintentional overdose fatalities in multiple states across the U.S. is likely to eventually result in scenarios where local and state authorities request support from EPA in the actual remediation of an indoor home or facility.

Fentanyl, a synthetic and short-acting opioid analgesic, is 50-100 times more potent than morphine and approved for managing acute (e.g., post-surgery) or chronic pain (e.g., advanced cancer). Although pharmaceutical fentanyl can be diverted for misuse, most cases of fentanyl-related morbidity and mortality have been linked to illicitly manufactured fentanyl and fentanyl analogs.

Fentanyl and fentanyl analogs ares sold via illicit drug markets for its heroin-like effect and often mixed with heroin and/or cocaine as a combination product—with or without the user's knowledge—to increase its euphoric effects. Fentanyl is also found to have been mixed with over the counter antihistamine medications. While fentanyl overdoses can be reversed with naloxone, a higher dose or multiple number of doses per overdose event may be required to revive a patient due to the high potency of some of the fentanyl analogs. The uneven distribution

of fentanyl powder in counterfeit pain and/or anxiety medications results in clustered overdose fatalities.

One of the main scientific gaps in the science behind a remediation response is a lack of knowledge on adequate decontamination technologies and their application conditions for direct neutralization of fentanyl on a material/surface. Current field remediation efforts are supposedly using physical removal approaches (e.g., fixation in a solution followed by vacuuming) or careful dry vacuuming following by "detergent and water" cleaning. Any method that does not degrade fentanyl will result in a waste stream containing fentanyl that must be dealt with.

Ongoing offsite NHSRC research efforts on fentanyl decontamination are focusing on surface decontamination approaches using liquid decontaminants. This has led to the preliminary identification of suitable decontamination chemistries at the bench scale. Here, the focus will be on approaches that can be implemented to clean hard to reach, hidden, surfaces via volumetric decontamination via fogging or fumigation.

This PWS describes decontamination research that is needed to develop a decontamination strategy for fentanyl contaminated indoor structures as to eliminate health risks following reoccupation of the premises. Research will be limited to remediation options for fentanyl only, excluding more potent fentanyl analogs such as carfentanyl. This WA is a continuation of research initiated under WA 3-097.

As part of this effort, EPA will develop a workgroup (the "Workgroup") composed of the work assignment contracting officer's representative (WACOR), alternate WACOR, subject matter experts from NHSRC, EPA's Office of Emergency Management (OEM), regional On-Scene Coordinators (OSCs) as well as State and Local Health officials who have firsthand knowledge of fentanyl contaminated sites and difficulties in cleanup procedures and who are directly impacted by responses related to the fentanyl opioid crisis. They will provide information to the Contractor via the WACOR on specific operational test conditions identified in the tasks below. The Workgroup will also be used by EPA to review deliverables from the Contractor.

Fentanyl is a Schedule II narcotic under the United States Controlled Substances Act of 1970. Hence, use of fentanyl for research purposes requires a Drug Enforcement Agency (DEA) license. A NC DHHS controlled substance license was received on February 14, 2019. A DEA license has been requested by the EPA WACOR and is being processed at the time of the writing of this PWS. Previous EPA onsite research with a different Schedule II simulant (methamphetamine) was approved by DEA.

SCOPE

This work will develop methods to investigate the decontamination of fentanyl on various surface types using volumetric cleanup approaches. Initial bench scale studies will consider the safe application of fentanyl powder in a confined area (e.g., fentanyl containing pouches or pre-shaped (stainless steel) material coupons) without the risk of accidental transfer of fentanyl powder without proper methods to clean such contaminated area. This WA will develop or demonstrate methods to deliver fentanyl via e.g., Drummond pipettes; extract fentanyl from

building materials via extraction and, as part of the scale-up, via wiping and/or vacuuming of surfaces in analogy to sampling efforts for biological spore forming agents. Research will continue at the pilot scale level using NHSRC's COMMANDER in which decon approaches will be tested under realistic conditions (e.g., a mock office) and which will include presence of other potential interfering chemicals. The final effort will involve the field demonstration of selected decon methodologies to State and Local stakeholders and video recording of such effort for additional outreach.

TECHNICAL APPROACH/OBJECTIVES

The main objective is to establish volumetric decontamination options that can be implemented as part of the remediation strategy for cleanup of fentanyl contaminated properties. The research will encompass bench scale and pilot scale decontamination research in combination with required method development and/or demonstration.

The test matrix will consider parameters such as decontamination type, decontaminant contact times; material types; fentanyl surface concentrations, and presence of interferents as observed in actual field responses. Specific details on these parameters will be provided by the WACOR to the contractor at the time of the development of the Quality Assurance Project Plan (QAPP).

The contractor shall perform the following specific tasks as part of this work assignment. The EPA WACOR will provide information on the onsite laboratory/laboratories who maintain liquid chromatography/mass spectrometry (LC/MS) capabilities. The chemical analysis for fentanyl shall be conducted by the contractor onsite via LC/MS at no cost to the WA except for purchase of supplies in coordination with the EPA WACOR. If the intended collaboration with onsite ORD laboratories is unsuccessful, the contractor shall expect to identify an accredited external chemical analysis laboratory that can provide the analytical support. Such change shall result in an amendment of this PWS as to reduce the number of intended tests under Tasks 2-7.

TASK 1: Preparation of the Quality Assurance Project Plan (QAPP)

At the time of the writing of this PWS, a draft QAPP was developed under WA 3-097 and reviewed by EPA QA. The contractor shall finalize and prepare amendments to a QAPP in accordance with Quality Assurance (QA) **Category B**. Attachment 1 to this PWS provides information regarding NHSRC QA Requirements/Definitions List. QAPPs prepared for a Category B (formerly known as a Category 3 or 4) project shall be developed in accordance with the document titled "EPA Requirements for Quality Assurance Project Plans." EPA QA/R-5 can be found at http://www.epa.gov/quality/qs-docs/r5-final.pdf and shall be approved prior to the start of any literature searches (existing data), data collection, gathering, synthesizing, or data generation (laboratory) work. Additional information related to QA requirements can be found at www.epa.gov/quality.

Deliverable: Draft QAPP to EPA WACOR was delivered under WA 3-097. The EPA WACOR, Workgroup and QA manager have reviewed the Draft QAPP and have provided comments back to the Contractor. A revised and final QAPP shall be submitted to EPA for final approval following revisions.

TASK 2: Safe Fentanyl Delivery for Bench-Scale Decontamination Experiments

The contractor shall develop a method to create gas/vapor permeable pouches containing precise amounts of fentanyl salts, hereafter defined as "fentanyl pouches or equivalent", at two mass levels, namely at 10-100 microgram level and at 1.0 milligram level. These pouches shall be designed as an approach to initiate volumetric decontamination testing without the risk of contaminating the test setup without proper cleanup methods available for full decontamination. The contractor may propose alternatives for the safe delivery of fentanyl powder onto a material. The contractor shall demonstrate successful recoveries of fentanyl from the pouches or equivalent through extraction of the contents/mass on coupons in an extraction solvent followed by quantification via liquid chromatography/mass spectrometry (LC/MS) or LC/MS/MS.

As part of this task, the concentrator shall also extract fentanyl contaminated coupons followed by gas chromatography (GC)/MS for a direct comparison of sensitivities between LC/MS and GC/MS.

Interim Deliverable: Demonstrated ability to create and fill fentanyl pouches or equivalent and adequate extraction efficiencies of fentanyl from such pouches at two weight fentanyl levels with emphasis on analysis by LC/MS. All demonstrations shall be at a minimum in triplicate.

TASK 3: Bench-Scale Volumetric Decontamination Experiments Part I

The contractor shall design a test matrix to measure decontamination efficiencies of up to four chemically different volumetric decontamination technologies. These may consist of vaporous hydrogen peroxide, chlorine dioxide gas, ethylene oxide gas, peracetic acid fogging, pH amended bleach fogging, ozone or another suitable and available volumetric decontamination technology. The contractor shall consider the use of a glove box to execute these tests similarly to previous onsite bio-decontamination efforts. For each technology, the contractor shall consider up to two conditions that differ in e.g., decontaminant vapor concentration or relative humidity. Each test shall use up to four contact times between contaminant and fentanyl containing pouches or equivalent with batches to be removed at specific contact times in a single volumetric decontamination test. Such tests shall be limited to eight hours in length but may extend to the next day due to aeration of the test environment. Each test shall be conducted using three fentanyl pouches or equivalent per time point and three positive controls per test run in combination with associated single procedural and laboratory blanks. Positive controls shall be identical to test coupons except for not being exposed to the decontamination technology. Fentanyl shall be extracted as per developed methods under Task 2.

Interim Deliverable: Decontamination efficiencies for up to four decontaminants at up to two experimental conditions and four contact times per decontaminant and experimental condition.

TASK 4: Method Development prior to Bench-Scale Volumetric Decontamination Experiments Part II

The Contractor shall perform method development studies pertaining to the delivery of reproducible amounts of solid fentanyl (1 mg target mass) onto small material coupons (10-100 cm^2 range), including spreading of the fentanyl powder over at least 50% of the coupon surface

and achieve acceptable recoveries of fentanyl from up to six types of surfaces via extraction into an organic solvent. Information on solvents will be provided by the EPA WACOR based on outcomes from Task 2 and concurrent fentanyl decontamination research. The contractor shall consider up to two solvents, which may vary based on the material.

The Contractor shall use as a minimum of triplicates during method development/ demonstrations and associated blanks and positive controls. Surfaces are likely to be selected by the Workgroup from indoor materials such as glass, vinyl tile, laminate, kitchen counter top, or galvanized metal and may include porous materials such as fabric, leather, or carpet. Developed methods shall pass the associated data quality objectives described in the QAPP developed under Task 1.

Interim Deliverable: Extraction efficiencies for fentanyl salt from six representative materials for up to two solvents.

TASK 5: Bench-Scale Volumetric Decontamination Experiments Part II

The contractor shall design a test matrix to measure decontamination efficiencies of up to three chemically different volumetric decontamination technologies based on the outcome from Task 3. For each technology, the contractor shall consider up to two conditions that differ in e.g., vapor concentration or relative humidity, based on results from Task 3. Each test shall consider using up to four contact times between contaminant and coupons contaminated with fentanyl with batches of coupons (six materials as per Task 4) to be removed at specific contact times in a single decontamination test. Such tests shall be limited to eight hours in length, excluding aeration of a chamber. Each test shall be conducted using three replicates per material per time point and three positive control coupons per material per test run in combination with associated procedural and laboratory blanks, both in duplicate. Coupons shall be extracted per developed methods under Task 4. Each test shall also include spike controls in which fentanyl is directly added to the extraction solvent.

Interim Deliverable: Recovered fentanyl mass from positive controls, test coupons for six materials at specific (four) contact times, procedural and laboratory blanks, and associated decontamination efficiencies.

TASK 6: Sampling method demonstration

The contractor shall work with the EPA WACOR to demonstrate a wipe and/or vacuum method to collect (residual) fentanyl from previously identified surfaces. Such method shall be verified against direct extraction, at two fentanyl surface concentrations and demonstrated on an up to 12" by 12" surface area. Wipe method demonstrations shall be in triplicate and include associated blanks and other reference coupons/materials

Interim Deliverable: Recovered fentanyl mass from wiping and/or vacuuming method at two fentanyl concentrations for six materials.

TASK 7: Pilot-Scale Volumetric Decontamination Experiments

The contractor shall create a mock office setup in NHSRC's COMMANDER facility to simulate a more holistic and realistic environment that would require decontamination. All six materials shall be present in this environment, either through placement of separate coupons or as part of furniture and/or structural material. The contractor shall design a test matrix to measure decontamination efficiencies of up to three chemically different volumetric decontamination technologies based on the outcomes from Tasks 3 and 5. The contractor shall utilize sampling methods demonstrated under Task 6. Each decon method shall be tested twice totaling six tests in COMMANDER.

Interim Deliverable: Recovered fentanyl mass from six materials present in mock office in COMMANDER after decontamination using up to three decontaminants (duplicate effort).

TASK 8: Demonstration of Volumetric Decontamination Approaches

The contractor shall create a mock office in e.g., a warehouse setting at a to be determined site and demonstrate the use of a successful decontamination technology using a fentanyl simulant and likely decontaminant simulant to demonstrate the operational aspects of the identified technology. The contractor shall then allow interested parties to gain hands-on experience on remediating such environment. The contractor shall record such activities as to inform responders who cannot participate.

Interim Deliverable: Notes on observations collected during demonstration and video recording (raw footage acceptable) of activities.

TASK 9: Report on Volumetric Decontamination Approaches

The contractor shall generate a data summary report for the volumetric decontamination tests related to the decontamination of fentanyl contaminated materials (Tasks 2-7). For this data summary report, the contractor shall create a draft version (Draft I) detailing a summary of findings, test conditions, methods, quality assurance, test results, and lessons learned from the testing described in this PWS. This data summary report shall include all procedural steps and any digital photos necessary to illustrate the findings. This Draft I version will be reviewed by the EPA WACOR and EPA product team.

A second version (Draft II) of the data summary report that incorporates the requested changes, corrections, and clarifications shall be submitted by the contractor following receipt of the combined comments from the EPA WACOR and EPA product team. This draft report (Draft II) will be submitted by the EPA WACOR for EPA peer reviews and Quality Assurance (QA) review.

A final data summary report incorporating requested changes, correction, and clarification resulting from the EPA review process shall be submitted by the contractor. A separate document detailing the response to EPA QA comments shall also be submitted to the EPA WACOR by the contractor together with the final version of the data summary report.

Deliverable: Draft and final data summary reports

INSTRUMENTATION/EQUIPMENT EXPECTATIONS

There are no instrumentation or equipment purchases anticipated under this WA.

QUALITY ASSURANCE

See Task 1 of Technical Approach section.

DELIVERABLES

1. The contractor shall transmit all data from Tasks 2-7. Raw and processed data shall be provided in MS Excel spreadsheets. Contractor shall transmit this data as soon as it has been internally reviewed for quality assurance.

2. The contractor shall create two draft data summary reports and a final report per Task 9 description.

3. On a monthly basis for the duration of the project, the contractor shall submit, in electronic format, progress reports summarizing technical progress (including estimated percent of project completed), problems encountered, cumulative financial expenditures and cost and schedule variance.

SCHEDULE OF DELIVERABLES

Deliverables are subject to completion of the previous task; hence, deliverables are described based on expected time to complete the research following completion. Due dates for Tasks 2-7 assume availability of fentanyl to contractor no later than April 1, 2019.

Task	**Deliverable**	**Due date**
1	Final QAPP	April 15, 2019
2	Task 2 Data in worksheet	May 15, 2019 or 6 weeks after receipt of fentanyl, whichever occurs last
3	Task 3 Data in worksheet	July 31, 2019 or 17 weeks after receipt of fentanyl, whichever occurs last
4	Task 4 Data in worksheet	July 31, 2019 or 17 weeks after receipt of fentanyl, whichever occurs last
5	Task 5 Data in worksheet	September 30, 2019 or 26 weeks after receipt of fentanyl, whichever occurs last
6	Task 6 Data in worksheet	October 31, 2019 or 30 weeks after receipt of fentanyl, whichever occurs last
7	Task 7 Data in worksheet	December 31, 2019 or 39 weeks after receipt of fentanyl, whichever occurs last
8	Notes and video material	January 31, 2020 (independent of fentanyl delivery date)
9	Draft summary reports; final summary report	February 15, 2020 (Draft I); March 8, 2020 (Draft II); and March 31 (Final)

EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 4-098

☐ Other ☐ Amendment Number:

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-15-008	04/01/2015 To 03/31/2020 Base Option Period Number 4	See attached PWS

Contractor	Specify Section and paragraph of Contract SOW
JACOBS TECHNOLOGY INC.	Section 2.0

Purpose:
- [X] Work Assignment
- [ ] Work Assignment Amendment
- [ ] Work Plan Approval
- [ ] Work Assignment Close-Out
- [ ] Incremental Funding

Period of Performance: From 04/01/2019 To 03/31/2020

Comments:

Work Plan due 4/29/19.

No work, including but not limited to preparation of the Work Plan, shall begin until 4/1/19.

☐ Superfund — Accounting and Appropriations Data — [X] Non-Superfund

SFO (*Max 2*) ☐

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code
1										
2										
3										
4										
5										

Authorized Work Assignment Ceiling

	Cost/Fee	LOE
Contract Period: 04/01/2015 To 03/31/2020		
This Action:		
Total:		

Work Plan / Cost Estimate Approvals

	Cost/Fee	LOE
Contractor WP Dated:		
Cumulative Approved:		

Work Assignment Manager Name: Joe Wood (Signature) (Date)	Branch/Mail Code: Phone Number: 919-541-5029 FAX Number: 919-541-0496
Project Officer Name: Robin S. Harris (Signature) (Date)	Branch/Mail Code: Phone Number: 919-541-0955 FAX Number:
Other Agency Official Name (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:
Contracting Official Name: Keith Pfeffer (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:

Performance Work Statement

WA Title: Decontamination of Vegetation
Work Assignment: 4-098
WACOR: Joseph Wood
Alternate WACOR: Lukas Oudejans
CONTRACT: EP-C-15-008
HS8.67.02-4501

PERIOD OF PERFORMANCE

The period of performance detailed in this Performance Work Statement (PWS) shall be from April 1, 2019 through March 31, 2020.

SUMMARY OF OBJECTIVES

The primary purpose of the study is to evaluate the efficacy of chemical-based techniques to decontaminate vegetation and plants contaminated with a Bacillus anthracis spore surrogate such as B. atrophaeus. Tests shall be conducted using various small live plants. Plant species shall be selected for testing in coordination with the WACOR and be representative of typical vegetation that may be encountered on a U.S. Coast Guard base. Another purpose of the study is to investigate the phytotoxicity of those decontaminants determined to be efficacious.

BACKGROUND

Following a bioterrorist attack, outdoor materials such as vegetation that become contaminated with a biological agent such as Bacillus anthracis pose significant human health threats. The EPA's NHSRC conducts research to develop methods and technologies to rapidly and cost-effectively remediate areas affected by a bioterrorism attack. Tasks performed under this work assignment support such research.

SCOPE

The results of the work conducted under this WA will provide data and information on possible approaches to decontaminate vegetation, based on efficacy results and initial assessments of the impact of decontaminants on vegetation. For the decontamination approaches that are effective for small plants, the study will also determine whether those decontaminants are toxic to the same plants. The results of this work will be made available through a published report, and possibly a conference abstract and presentation.

TECHNICAL APPROACH/OBJECTIVES

Method development tests may be needed to ensure spore inoculation and sampling methods for small plants are adequate. The contractor shall construct or purchase a small greenhouse to allow plants to grow in a mostly controlled environment during the phytotoxicity test phase. These phytotoxicity tests will be selected at the time of writing the QAPP, but are expected to be simple tests such as evaluating leaf color changes and plant viability over time (a few months).

The contactor shall perform the following tasks.

Task 1. Preparation of the Quality Assurance Project Plan (QAPP).

The Contractor shall prepare a first draft of the QAPP (if not already prepared in previous WA 3-098) in accordance with Quality Assurance (QA) Category B. Attachment 1 to the Performance Work Statement (PWS) provides information regarding NHSRC QA Requirements/Definitions

List. QAPPs prepared for a Category B (formerly known as a Category 3 or 4) project shall be developed in accordance with the document titled "EPA Requirements for Quality Assurance Project Plans." EPA QA/R-5 can be found at http://www.epa.gov/quality/qs-docs/r5-final.pdf and shall be approved by an EPA Quality Assurance Manager (QAM) prior to the start of any literature searches (existing data), data collection, gathering, synthesizing, or data generation (laboratory) work. Additional information related to QA requirements can be found at www.epa.gov/quality.

Task 2 below shall be used to inform writing of the QAPP.

Task 2. Conduct method development tests to assess procedures for inoculation of small plants with bacterial spores and subsequent sampling of small plants

The contractor shall conduct these tests with the aim of informing development of procedures and writing of the QAPP (to be developed under Task 1) and per the following requirements:

A. Microbiological and related methods (e.g., spore preparation, sterilization, numbers of replicates and blanks, inoculation of spores, recovery and quantitation of spores, characterization of efficacy, air and water sample collection and analysis, etc.) conducted under this WA shall be documented in the QAPP, and shall be consistent with previous work conducted under this contract. Quality control/quality assurance procedures for all microbiological related analyses and measurements shall be documented in the QAPP. All work conducted in the bio-contaminant laboratory for this sub-task shall be charged to this WA.

B. Develop an aerosol deposition apparatus (ADA) that can be used with a metered dose inhaler to inoculate small plants. The plants shall be selected in coordination with the WACOR. Alternatively, develop a liquid sprayer technique to inoculate the small plants with spores. Evaluate the spore spatial coverage over several plants and total inoculation levels.

C. Develop a method to quantify total number of spores (e.g., colony forming units, or CFU) on a small plant. This shall include development of sampling procedures and/or extraction of plant materials (e.g., leaves), with subsequent standard spiral plating techniques.

Task 3. Develop a chamber or set up a small greenhouse to conduct subsequent phytotoxicity tests on plants

A. In consultation with the WACOR, the contractor shall either (1) refurbish an existing indoor chamber (possibly the chamber in H122) with plant grow lights or (2) set up a small greenhouse. The purpose of the plant grow chamber or greenhouse shall be to house and care for several plants while phytotoxicity assessments take place over a few months. Some of the decontaminants tested on plants may be toxic to the plants.

Task 4. Conduct tests to evaluate efficacy of various decontaminant solutions for inactivating Bg spores on different plant types, under a variety of test conditions.

The contractor shall conduct these tests in accordance with the QAPP developed in Task 1 and per the following requirements:

A. Microbiological and related methods (e.g., spore preparation, sterilization, numbers of replicates and blanks, inoculation of spores, recovery and quantitation of spores, characterization of efficacy, air and water sample collection and analysis, etc.) conducted under this WA shall be documented in the QAPP, and shall be consistent with previous work conducted under this contract. Quality control/quality assurance procedures for all microbiological related analyses and measurements shall be documented in the QAPP. All work conducted in the bio-contaminant laboratory for this sub-task shall be charged to this WA. Methods for inoculation of plants, and sampling of plants (for both positive controls and the test plants exposed to decontaminant), shall be consistent with the method development work conducted in Task 2 of this WA.

B. Conduct tests in a spray chamber or COMMANDER to assess inactivation efficacy of decontaminant solutions at various concentrations, contact times, and other variables. The plants, decontaminants, and other variable parameters shall be selected in consultation with the WACOR. A tentative test matrix for this task includes the following variables:
   - **a.** 4-5 types of plants, with a sufficient number of replicates
   - **b.** 4-5 decontaminants and/or decontaminant concentrations
   - **c.** 2-3 contact times
   - **d.** With and without rinsing plants with water after contact time with decontaminant
   - **e.** 2-3 application methods, including spray and electrostatic spray
   - **f.** Other variables to be determined

C. This test matrix shall be finalized during the writing of the QAPP in Task 1. Three to five replicates of each plant shall be used, as well as a similar number of positive controls. Contact times may range from a few minutes to a few hours, depending on temperature. Spores shall be recovered from plant materials and quantified according to QAPP.

D. Collect and quantitate spores in air samples (such as those collected on filters using a Dry Filter Unit) as well as any liquid runoff samples, that may occur as a result of applying decontaminant.

E. Measurement and characterization of decontaminant solutions, including parameters such as pH and free available chlorine, peracetic acid concentration, etc., shall be conducted for each experiment and according to the QAPP and previous methods used under this contract.

F. Measurement and logging of data for the chamber and operational parameters, such as temperature (and possibly relative humidity), shall be conducted for each experiment according to the QAPP.

Task 5. Conduct phytotoxicity tests

The contractor shall assess the phytotoxicity of two decontaminants shown to be the most effective in inactivating spores on plants, based on the results in Task 4, and in accordance with the QAPP. These decontaminants shall be selected in consultation with the WACOR. The decontaminants shall be applied to the same types of plants (but new ones) used in Task 4, and

using the same application methods used in Task 4, but without the use of spores. Plants shall then be taken to the greenhouse (Task 3) to begin assessment of detrimental impacts to the plants. These assessments shall last no longer than three months, and consist primarily of visually assessing leaf color changes, loss of leaves or plant matter, and/or whether the plants have died. These simple and basic specific phytotoxic assessments, including the frequency thereof, shall be defined in the writing of the QAPP.

Task 6. Provide general support for maintaining the lab and plant related equipment.
This support shall include assembly, maintenance, troubleshooting, and configuration support for any equipment used for testing. Support shall also include the purchase of any expendable materials, with prior approval from the WACOR, for use in this project.

Task 7. Report the results of all tests to the WACOR as soon as possible.
Report the results of each test to the WACOR within 7 days, via email and through the use of the DTRL share drive. The WACOR shall be notified immediately of any problems encountered in the laboratory or with the results obtained. These data shall include data from biolab, any generated data files (i.e., logged data) properly annotated, reports of the experimental conditions, calibration checks, measured variables, and a listing of the samples awaiting further analysis.

Task 8. Meet with the WACOR
Meet with the WACOR at least every week to provide a project status update. The update shall include a synopsis of activities taking place the past week, problems encountered, and work planned for the next week.

Task 9. Prepare monthly reports
Prepare monthly reports to EPA that summarize work activities (accomplished and planned) in this work assignment, including the status of applicable test, QA, and safety plans. The monthly report shall also detail labor costs and ODC charges. The ODC charges shall be documented in the report in a way that the items purchased, vendor, and cost are clearly indicated.

Task 10. Prepare test report
Prepare a draft test report, and based on comments received from the WACOR, revise the report to produce a final test report. The scope of the report shall be similar to previous EPA published reports. Alternatively, a draft journal article may be prepared.

INSTRUMENTATION/EQUIPMENT EXPECTATIONS
All tasks described in this PWS shall be performed in-house, at the EPA's Research Triangle Park (RTP) facilities.

DELIVERABLES

Data Delivery
Raw data from the biolab (e.g., plate counts, qualitative growth results, etc.) shall be emailed to the WACOR, and by carbon copy (cc) to the WACOR of the project the microbiology lab is supporting, as soon as the data become available (not greater than 2 working days after completion of the analysis generating the data).

Reporting

The Contractor shall provide written monthly status reports using an MS WORD format to the EPA Biocontaminant lab WACOR. The reports shall be prepared specifying the following: (1) summary of work conducted during the preceding months, including tables and/or charts using MS EXCEL format, as appropriate, with sufficient annotation as deemed adequate by the EPA WACORs, (2) analyses of the work in accordance to the expectations specified by the QAPP of each project, (3) progress on each task and the reason for any deviations from the project schedule, and (4) work anticipated during the coming quarter. These reports shall be submitted electronically near the end of each quarter. Additionally, pdf copies of the laboratory notebook, including the pages documenting activities performed during the period, shall be created and delivered electronically to the WACOR the same day the quarterly report is delivered.

SCHEDULE OF DELIVERABLES

The following table outlines the schedule that the contractor shall meet for the period covered by this PWS. Dates dependent upon completion of specific tasks shall be updated based on discussions between the contractor WAL and EPA WACOR during the development of the test plans to cover the work specified herein.

Deliverable Schedule - Some of these dates will depend on completion of tasks in previous WA 3-098:

Deliverable	**Completion Date**
Submit work plan	In accordance with the WA cover page
Complete first draft of QAPP (Task 1)	May 30, 2019
Complete method development tests (Task 2)	April 30, 2019
Complete set up of greenhouse or refurbishment of chamber for subsequent phytotoxicity tests (Task 3)	May 30, 2019
Complete plant decontamination tests	October 30, 2019
Conduct phytotoxicity assessments	December 30 2019
Submit draft test report	February 15, 2020

Attachment 1 to the Performance Work Statement

NHSRC QA Requirements/Definitions List

EPA=s Quality System Website: http://www.epa.gov/quality

In accordance with EPA CIO 2105.0 (Order), EPA 2105-P-01-0 (Manual), and conformance to ANSI/ASQC E4 must be demonstrated by submitting the quality documentation described herein. All Quality documentation shall be submitted to the Government for review. The Government will review and return the quality documentation, with comments, and indicate approval or disapproval. If the quality documentation is not approved, it must be revised to address all comments and shall be resubmitted to the Government for approval. Work involving environmental data collection, generation, use, or reporting shall not commence until the Government has approve the quality documentation. The Quality Assurance Project Plan (QAPP) shall be submitted to the Government at least thirty (30) days prior to the beginning of any environmental data gathering or generation activity in order to allow sufficient time for review and revisions to be completed. After the Government has approved the quality documentation, the Performer shall also implement it as written and approved by the Government.

NHSRC's Quality System Specifications for Extramural Actions –

These requirements typically pertain to single project efforts. The five specifications are:

(1) a description of the organization's Quality System (QS) and information regarding how this QS is documented, communicated and implemented;

(2) an organizational chart showing the position of the QA function;

(3) delineation of the authority and responsibilities of the QA function;

(4) the background and experience of the QA personnel who will be assigned to the project; and

(5) the organization's general approach for accomplishing the QA specifications in the PWS.

NHSRC QA Requirements/Definitions List

Category Level Designations (determines the level of QA required):

☐ **Category A Project (formerly Category 1 and 2)** – applies to research that is anticipated to result in high-visibility products. In this case, the QAPP shall address all elements listed in "EPA Requirements for QA Project Plans, EPA QA/R-5. **http://www.epa.gov/quality/qs-docs/r5-final.pdf**

Research of this nature meets one or more of the following criteria:

- Results are ISI
- Has a high probability the results could be used in litigation or enforcement
- Is a HISA
- Direct regulatory support

X **Category B Project (formerly Category 3 and 4)** applicable to projects that do not meet the criteria for Category A. In lieu of using "EPA Requirements for QA Project Plans, EPA QA/R-5, a QAPP may be develo0ped in accordance with NHSRC's QAPP requirement templates. This decision is made by the Principal Investigator or lead researcher.

Additional information regarding **QAPP** requirements for a specific project type are provided below.

Project Types:

NHSRC's QAPP Requirements templates are available for Applied Research Projects, Sampling and analysis Project, Method Development Project, and Existing Data Project. These templates are condensed from applicable sections of R-5 (EPA Requirements for QA Project Plans) and are intended to serve as a starting point when preparing a QAPP. These templates and their format may not fit every research scenario and QAPP's must conform to applicable sections of R-5 in a way that fully describes the research plan and appropriate QA and QC measures to ensure that the data are of adequate quality and quantity to fit their intended purpose.

Note: the template should be provided as Attachment 2 to the SOW or PWS.

X **Applied Research Project** - pertains to a study performed to generate data to demonstrate the performance of accepted processes or technologies under defined conditions. These studies are often pilot- or field-scale.

☐ **Sampling and Analysis Project** - pertains to the collection and analysis of samples with no objectives other than to provide characterization or monitoring information.

☐ **Existing Data Project** - pertains to environmental data collected from other sources, by or for EPA, that are used for purposes other than those originally intended. Sources may include: literature, industry surveys, compilations from computerized databases and information systems, and computerized or mathematical models of environmental processes.

☐ **Method Development Project** - pertains to situations where there is no existing standard method, or a standard method needs to be significantly modified for a specific application.

For other types of project types, the EPA Guidance documents are available. All QAPPs must conform to applicable sections of R-5 in a way that fully describes the research plan and appropriate QA and QC measures to ensure that the data are of adequate quality and quantity to fit their intended purpose. The specific and general guidance documents can be found at http://www.epa.gov/quality/qa_docs.html#guidance

☐ **Design, Construction, and/or Operation of Environmental Technology Project** - pertains to environmental technology designed, constructed and/or operated by and/or for EPA. The QAPP shall address requirements in the EPA Quality System document "Guidance on Quality Assurance for Environmental Technology Design, Construction, and Operation" (EPA QA/G-11)

☐ **Geospatial Data Quality Assurance Project** - pertains to data collection; data processing and analysis; and data validation of geospatial applications. The QAPP shall address requirements in the EPA Quality System document "Guidance for Geospatial Data Quality Assurance Project Plans" EPA QA /G-5S).

☐ **Model Development Project** - includes all types of mathematical models including static, dynamic, deterministic, stochastic, mechanistic, empirical, etc. The QAPP shall address requirements in the EPA Quality System document "Guidance for Quality Assurance Project Plans for Modeling" (EPA QA/G-5M)

Definitions:

Environmental Data - These are any measurement or information that describe environmental processes, location, or conditions; ecological or health effects directly from measurements, produced from software and models, and compiled from other sources such as data bases or the literature. For EPA, environmental data include information collected directly from measurements, produced from software and models, and compiled from other sources such as data bases or literature.

Incremental Funding - Incremental funding is partial funding, no new work.

Quality Assurance (QA) - Quality assurance is a system of management activities to ensure that a process, item, or service is of the type and quality needed by the customer. It deals with setting policy and running an administrative system of management controls that cover planning, implementation, and review of data collection activities and the use of data in decision making. Quality assurance is just one part of a quality system.

Quality Assurance Project Plan (QAPP) - A QAPP is a document that describes the necessary quality assurance, quality control, and other technical activities that must be implemented to ensure that the results of the work performed will satisfy the stated performance criteria. A QAPP documents project-specific information.

Quality Control (QC) - Quality control is a technical function that includes all the scientific precautions, such as calibrations and duplications, which are needed to acquire data of known and adequate quality.

Quality Management Plan (QMP) - A QMP is a document that describes an organization's/program's quality system in terms of the organizational structure, policy and procedures, functional responsibilities of management and staff, lines of authority, and required interfaces for those planning, implementing, documenting, and assessing all activities conducted. A QMP documents the overall organization/program, and is primarily applicable to multi-year, multi-project efforts. An organization's/program's QMP shall address all elements listed in the "Requirements for Quality Management Plans" in Appendix B of the NHSRC QMP.

Quality System - A quality system is the means by which an organization manages its quality aspects in a systematic, organized manner and provides a framework for planning, implementing, and assessing work performed by an organization and for carrying out required quality assurance and quality control activities.

R-2. EPA Requirements for Quality Management Plans (EPA/240/B-01/002) March, 2001
http://www.epa.gov/quality/qs-docs/r2-final.pdf

R-5. EPA Requirements for Quality Management Plans (EPA/240/B-01/002) March, 2001
http://www.epa.gov/quality/qs-docs/r5-final.pdf

Substantive Change Substantive change is any change in an activity that may alter the quality of data being used, generated, or gathered.

Principal Investigator (PI) - This person is technically responsible for the project. For extramural contract work, the PI is typically the contracting officer's representative (COR). For intramural work, the lead researcher is typically the Principal Investigator.

Abbreviations:

COR - Contracting Officer's Representative
NHSRC - National Homeland Security Research Center
QA ID Quality Assurance Identification
QAPP Quality Assurance Project Plan
QS – quality system
PI - Principal Investigator

EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 4-099

☐ Other ☐ Amendment Number:

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-15-008	04/01/2015 To 03/31/2020 Base Option Period Number 4	See attached PWS

Contractor	Specify Section and paragraph of Contract SOW
JACOBS TECHNOLOGY INC.	Section 2.0

Purpose:
- [X] Work Assignment
- [ ] Work Assignment Amendment
- [ ] Work Plan Approval
- [ ] Work Assignment Close-Out
- [ ] Incremental Funding

Period of Performance: From 04/01/2019 To 03/31/2020

Comments:

Work Plan due 4/29/19.

No work, including but not limited to preparation of the Work Plan, shall begin until 4/1/19.

☐ Superfund — Accounting and Appropriations Data — [X] Non-Superfund

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

SFO (*Max 2*) ☐

Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code
1										
2										
3										
4										
5										

Authorized Work Assignment Ceiling

	Cost/Fee	LOE
Contract Period: 04/01/2015 To 03/31/2020		
This Action:		
Total:		

Work Plan / Cost Estimate Approvals

	Cost/Fee	LOE
Contractor WP Dated:		
Cumulative Approved:		

Work Assignment Manager Name: John Archer (Signature) (Date)	Branch/Mail Code: Phone Number: 919-541-1151 FAX Number:
Project Officer Name: Robin S. Harris (Signature) (Date)	Branch/Mail Code: Phone Number: 919-541-0955 FAX Number:
Other Agency Official Name: (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:
Contracting Official Name: Keith Pfeffer (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:

Performance Work Statement

WA Title: Comparison of DNATrax and Bacillus anthracis Surrogate Resuspension from Subway Surfaces

WA #: 4-099 WACOR: John Archer

Contract #: EP-C-15-008 Alternate WACOR: Worth Calfee

NOTE: This is a continuation of a WA from Option Period 3.

PERIOD OF PERFORMANCE

The period of performance detailed in this Performance Work Statement (PWS) shall be from April 1, 2019 through March 31, 2020.

SUMMARY OF OBJECTIVES

In the event of a release of biological material in an urban area that would require decontamination for the purpose of public safety, the potential resuspension of said materials is of great interest to EPA and the Department of Homeland Security. In such an event, a wide range of surfaces would be contaminated. The Environmental Protection Agency (EPA) has the responsibility for protecting human health and the environment from secondary emission (resuspension) of materials from these areas. EPA may be required to mitigate, provide consequence management, and decontaminate the area of concern. To this end, the EPA Office of Research and Development (ORD) National Homeland Security Research Center (NHSRC), Decontamination and Consequence Management Division (DCMD) is conducting research to investigate resuspension from subway surfaces for B. anthracis surrogate particles using the Aerosol Test Facility (ATF). Results from these experiments will benefit both DHS and EPA's efforts to better understand the resuspension behavior of biological surrogates and determine which surrogates are most appropriate to use in outdoor release studies.

BACKGROUND

Under Homeland Security Presidential Directive (HSPD) 10, the U.S. Department of Homeland Security (DHS) is tasked to coordinate with other appropriate Federal departments and agencies, to develop comprehensive plans which, "provide for seamless, coordinated Federal, state, local, and international responses to a biological attack." As part of these plans, the U.S. Environmental Protection Agency (EPA), in a coordinated effort with DHS, is responsible for "developing strategies, guidelines, and plans for decontamination of persons, equipment, and facilities" to mitigate the risks of contamination following a biological weapons attack.

EPA's National Homeland Security Research Center (NHSRC) provides expertise and products that can be widely used to prevent, prepare for, and recover from public health and environmental emergencies arising from terrorist threats and incidents.

An urban subway system is a logical target for the release of a biological agent. A typical subway platform at rush hour offers numerous confined human targets, a train-driven mechanism for extended and rapid dissemination, and minimal security. To counteract this threat, the DHS

S&T recently funded a comprehensive project (known as the Underground Transport Restoration, or UTR) to examine the effects from an aerosol release of a biological agent surrogate in the subway and test strategies and methods for sampling and remediation of the New York City subway system. A particle and gas dispersion measurement campaign was included as part of the UTR study to understand the full extent of contamination from an attack. The results, and concurrent dispersion modeling of the environment, suggest that particle resuspension from the infrastructure and other fomites (objects or materials capable of infectious agent transfer) may contribute to the spread of contamination to the outer reaches of the system and beyond. Deposited material within the subway system may also be reaerosolized by train movements and/or human activity. Secondary contamination could be transferred to businesses, residences, airports, hospitals, and command and control centers, complicating response and remediation actions and extending the threat to public health.

Currently, a key area of uncertainty is the degree to which the inert simulant DNATrax used for the UTR dissemination study, resembles and behaves like an actual biological agent, i.e., Bacillus anthracis (Ba). DNATrax is a short-chain DNA-infused, water-soluble, maltodextrin particle. The actual bacterial threat material of interest is an endospore particle whose physical properties vary greatly depending upon preparation methods. Another key area of uncertainty is the degree of resuspension itself from passengers as experimental data that currently exist have 1-2 orders of magnitude of uncertainty, especially with respect to substrate, particle size, and potential passenger activity.

The resuspension and fomite transport behavior of the simulant must be evaluated to determine if UTR-based contamination predictions would hold for dissemination of Ba (and possibly other biological warfare agents) and to provide additional data to verify and strengthen models of fomite transfer. This is particularly important since DHS will be sponsoring a new and larger particle dispersion measurement campaign in New York City in 2020 that will involve both outdoor and indoor releases, focusing on the exchange of material between the subway and street and the extent of contamination into neighboring boroughs. The results of these new measurements will be driven even more significantly by resuspension and fomite transport effects. Therefore, to provide NYC stakeholders, first responders, and the modeling community with reliable results as well as inform emergency preparedness actions, quantitative measurements comparing the resuspension properties of Ba (or suitable surrogate) and the publicly-released simulant DNATrax are necessary.

SCOPE

The experimental scope of this WA will focus on resuspension from typical subway surfaces through comparison testing of DNATrax and Btk through the following tasks which are explained in detail in the next section. A list of tasks is shown below. The purpose of this Work Assignment (WA) is to conduct research to fill some of the key knowledge gaps in the area of outdoor resuspension/reaerosolization.

Tasks:

1. Procurement of DNATrax and Btk and establishment of analytical methods (continuing from Option Period 3)
2. Development of dry deposition methods for coupon inoculation/seeding (continuing from Option Period 3)
3. Conducting controlled tests for the Comparative Resuspension Study
4. Data analysis, reporting, and technical editing

TECHNICAL APROACH/OBJECTIVES

The contractor, upon approval from the EPA WACOR, shall procure all test equipment and materials to be included in this project. See below for a breakout of tasks covered under this WA which include the technical approach.

A series of reports have been produced by EPA on prior studies to quantify resuspension of spores and other surrogates from common outdoor surfaces. A set of laboratory experiments has been completed studying the degree of resuspension of bar-coded BtK spores under a variety of test conditions. All prior reports and documentation for prior studies conducted for EPA will be made available to the contractor upon request.

The following tasks are defined as part of this work assignment:

Task 1. Procurement of DNATrax and Ba surrogate and establishment of analytical methods for resuspension comparison (procurement completed in Option Period 3; analytical method development will continue in Option Period 4)

The Contractor shall determine the best mechanism for procurement of the DNATrax material and Ba surrogate spores and the amounts needed that shall be used for the depositions, controlled resuspension testing and development of analytical methods. The Contractor shall work with the WACOR on coordination of materials shipments. The Contractor shall not be responsible for payment of DNATrax materials through the WA. Polymerase Chain Reaction (PCR) analytical methods and other appropriate methods shall be used for the resuspension comparison of DNATrax and Ba surrogate. The analytical methods shall be developed by the Contractor in house specifically for this comparative resuspension testing and include, but are not limited to, PCR, fluorometric methods, and electron microscopy.

Task 2. Development of dry deposition methods for coupon inoculation/seeding with Ba surrogate and DNATrax (continuing from Option Period 3)

The Contractor, in conjunction with the EPA WACOR, shall develop repeatable, uniform dry deposition methods utilizing previously established EPA deposition methods or development of new methods utilizing dispersion devices used by DHS in previous NY City Subway DNATrax dispersion studies. The same dry deposition methods shall be used for DNATrax and Ba surrogate. This shall be conducted during scoping/scouting testing.

Task 3. Conduct controlled tests for the Comparative Resuspension Study:

The contractor shall, upon approval from the WACOR, (including QAPP, IRB (if applicable), etc., approval) execute controlled experiments in the Aerosol Test Facility to assess reaerosolization of spores from agreed upon surfaces (porous and non-porous) while subjecting coupons to highly-controlled and repeatable conditions that are hypothesized to affect resuspension (i.e., wind speed and RH). The amount of material resuspended shall be measured and compared to the amount remaining on the coupons. Resuspension fractions for the test materials shall be calculated and compared to assess resuspension behavior.

Task 4: Data Analysis, Final Reporting and Technical Editing:

The Contractor shall provide data analysis for data generated during Task 3, including statistical analysis utilizing methods such as ANOVA and PCA to determine the key test parameters impacting resuspension and provide a final report. The contractor shall interpret study results and utilize this information and data to determine (and where necessary test) new hypotheses relevant to study results. The contractor shall provide all necessary statistical and technical editing support for NHSRC projects.

INSTRUMENTATION/EQUIPMENT EXPECTATIONS

This effort is labor intensive, which is where the bulk of the funding is required. Some sampling equipment and materials may need to be purchased under this WA. The contractor shall procure all test materials/equipment necessary for the work, unless otherwise specified by the WACOR. Instrumentation for analysis is already onsite at EPA. The work shall be conducted at EPA's RTP Aerosol Test Facility (ATF) with laboratory analysis provided by the NHSRC Biolab.

QUALITY ASSURANCE

The contractor shall work with the EPA WACOR to develop the Quality Assurance Project Plan (QAPP) and test plan which will be approved by the EPA NHSRC QA Manager. NHSRC QA Requirements are listed in Attachment A. The EPA WACOR will assemble a team of EPA employees and other federal agency staff that will assist in the development of this project and provide feedback on the progress.

DELIVERABLES

- On a monthly basis for the duration of the project, the contractor shall submit, in electronic format, progress reports summarizing technical progress (including estimated percent of project completed), problems encountered, quarterly and cumulative financial expenditures and cost and schedule variance.
- QAPP/Test Plan completed in Option Period 3. Revisions as necessary, shall be completed in Option Period 4.
- Draft Final Report within 2 months from completion of Task 3.
- Final Report within 2 weeks after receiving review comments from EPA.

SCHEDULE OF DELIVERABLES

Deliverable	Date
QAPP/Test Plan/HASP	Revisions to QAPP/Test Plan in Option Period 4 as necessary.
Monthly reports and bi-weekly email summaries	Reports by the end of each month and email status summaries bi-weekly in preparation for EPA bi-weekly calls with DHS.
Draft Final Report	2 months from completion of Task 3
Final Report	2 weeks after receiving review comments from EPA

REPORTING REQUIREMENTS

- The Contractor shall prepare Quality Control data reports of all facility-specific data. Each Quality Control report shall be in a format suitable for EPA/NHSRC publication and shall discuss how well various measurements described in the QA plan were met.
- The monthly invoice reports for this work assignment shall provide a detailed description of any equipment or expendables that have been purchased by the contractor for use on the projects discussed herein. The bi-weekly email summaries shall be provided to the WACOR 1 day prior to bi-weekly EPA/DHS calls. Call schedule will be provided by the WACOR.
- In lieu of a final technical report, journal papers within each task may be submitted at the discretion of the EPA WACOR. The papers shall be authored or co-authored by the EPA WACOR, at the discretion of the WACOR. To serve in lieu of the final technical report, journal articles shall contain all information that would have appeared in the final report.
- All products developed under this PWS shall conform to the requirements of EPA's Handbook for Preparing Office of Research and Development Reports (EPA/800/K-95/002). Substantive portions of this handbook can be found at www.epa.gov/nhsrc under the policy and guidance tab.

Attachment A to the PWS

NHSRC QA Requirements/Definitions List

EPA=s Quality System Website: http://www.epa.gov/quality

In accordance with EPA CIO 2105.0 (Order), EPA 2105-P-01-0 (Manual), and conformance to ANSI/ASQC E4 must be demonstrated by submitting the quality documentation described herein. All Quality documentation shall be submitted to the Government for review. The Government will review and return the quality documentation, with comments, and indicate approval or disapproval. If the quality documentation is not approved, it must be revised to address all comments and shall be resubmitted to the Government for approval. Work involving environmental data collection, generation, use, or reporting shall not commence until the Government has approve the quality documentation. The Quality Assurance Project Plan (QAPP) shall be submitted to the Government at least thirty (30) days prior to the beginning of any environmental data gathering or generation activity in order to allow sufficient time for review and revisions to be completed. After the Government has approved the quality documentation, the Contractor shall also implement it as written and approved by the Government.

NHSRC's Quality System Specifications for Extramural Actions –

These requirements typically pertain to single project efforts. The five specifications are:

(1) a description of the organization's Quality System (QS) and information regarding how this QS is documented, communicated and implemented;

(2) an organizational chart showing the position of the QA function;

(3) delineation of the authority and responsibilities of the QA function;

(4) the background and experience of the QA personnel who will be assigned to the project; and

(5) the organization's general approach for accomplishing the QA specifications in the SOW.

NHSRC QA Requirements/Definitions List

Category Level Designations (determines the level of QA required):

☐ **Category A Project (formerly Category 1 and 2)** – applies to research that is anticipated to result in high-visibility products. In this case, the QAPP shall address all elements listed in "EPA Requirements for QA Project Plans, EPA QA/R-5. **http://www.epa.gov/quality/qs-docs/r5-final.pdf**

Research of this nature meets one or more of the following criteria:

- Results are ISI
- Has a high probability the results could be used in litigation or enforcement
- Is a HISA
- Direct regulatory support

☐ **Category B Project (formerly Category 3 and 4)** - applicable to projects that do not meet the criteria for Category A. In lieu of using "EPA Requirements for QA Project Plans, EPA QA/R-5, a QAPP may be develo0ped in accordance with NHSRC's QAPP requirement templates. This decision is made by the Principal Investigator or lead researcher.

Additional information regarding Q**APP** requirements for a specific project type are provided below.

Project Types:

NHSRC's QAPP Requirements templates are available for Applied Research Projects, Sampling and analysis Project, Method Development Project, and Existing Data Project. These templates are condensed from applicable sections of R-5 (EPA Requirements for QA Project Plans) and are intended to serve as a starting point when preparing a QAPP. These templates and their format may not fit every research scenario and QAPP's must conform to applicable sections of R-5 in a way that fully describes the research plan and appropriate QA and QC measures to ensure that the data are of adequate quality and quantity to fit their intended purpose.

Note: the template should be provided as Attachment 2 to the SOW or PWS.

☐ **Applied Research Project** - pertains to a study performed to generate data to demonstrate the performance of accepted processes or technologies under defined conditions. These studies are often pilot- or field-scale.

☐ **Sampling and Analysis Project** - pertains to the collection and analysis of samples with no objectives other than to provide characterization or monitoring information.

☐ **Existing Data Project** - pertains to environmental data collected from other sources, by or for EPA, that are used for purposes other than those originally intended. Sources may include: literature, industry surveys, compilations from computerized databases and information systems, and computerized or mathematical models of environmental processes.

☐ **Method Development Project** - pertains to situations where there is no existing standard method, or a standard method needs to be significantly modified for a specific application.

For other types of project types, the EPA Guidance documents are available. All QAPPs must conform to applicable sections of R-5 in a way that fully describes the research plan and appropriate QA and QC measures to ensure that the data are of adequate quality and quantity to fit their intended purpose. The specific and general guidance documents can be found at http://www.epa.gov/quality/qa_docs.html#guidance

☐ **Design, Construction, and/or Operation of Environmental Technology Project** - pertains to environmental technology designed, constructed and/or operated by and/or for EPA. The QAPP shall address requirements in the EPA Quality System document "Guidance on Quality Assurance for Environmental Technology Design, Construction, and Operation" (EPA QA/G-11)

☐ **Geospatial Data Quality Assurance Project** - pertains to data collection; data processing and analysis; and data validation of geospatial applications. The QAPP shall address requirements in the EPA Quality System document "Guidance for Geospatial Data Quality Assurance Project Plans" EPA QA /G-5S).

☐ **Model Development Project** - includes all types of mathematical models including static, dynamic, deterministic, stochastic, mechanistic, empirical, etc. The QAPP shall address requirements in the EPA Quality System document "Guidance for Quality Assurance Project Plans for Modeling" (EPA QA/G-5M)

Definitions:

Environmental Data - These are any measurement or information that describe environmental processes, location, or conditions; ecological or health effects directly from measurements, produced from software and models, and compiled from other sources such as data bases or the literature. For EPA, environmental data include information collected directly from measurements, produced from software and models, and compiled from other sources such as data bases or literature.

Incremental Funding - Incremental funding is partial funding, no new work.

Quality Assurance (QA) - Quality assurance is a system of management activities to ensure that a process, item, or service is of the type and quality needed by the customer. It deals with setting policy and running an administrative system of management controls that cover planning, implementation, and review of data collection activities and the use of data in decision making. Quality assurance is just one part of a quality system.

Quality Assurance Project Plan (QAPP) - A QAPP is a document that describes the necessary quality assurance, quality control, and other technical activities that must be implemented to ensure that the results of the work performed will satisfy the stated performance criteria. A QAPP documents project-specific information.

Quality Control (QC) - Quality control is a technical function that includes all the scientific precautions, such as calibrations and duplications, which are needed to acquire data of known and adequate quality.

Quality Management Plan (QMP) - A QMP is a document that describes an organization's/program's quality system in terms of the organizational structure, policy and procedures, functional responsibilities of management and staff, lines of authority, and required interfaces for those planning, implementing, documenting, and assessing all activities conducted. A QMP documents the overall organization/program, and is primarily applicable to multi-year, multi-project efforts. An organization's/program's QMP shall address all elements listed in the "Requirements for Quality Management Plans" in Appendix B of the NHSRC QMP.

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http://www.epa.gov/quality/qs-docs/r2-final.pdf

R-5. EPA Requirements for Quality Management Plans (EPA/240/B-01/002) March, 2001
http://www.epa.gov/quality/qs-docs/r5-final.pdf

Substantive Change - Substantive change is any change in an activity that may alter the quality of data being used, generated, or gathered.

Principal Investigator (PI) - This person is technically responsible for the project. For extramural contract work, the PI is typically the contracting officer's representative (COR). For intramural work, the lead researcher is typically the Principal Investigator.

Abbreviations:

COR	Contracting Officer
IAG	Interagency Agreement
NHSRC	National Homeland Security Research Center
PI	Principal Investigator
QA	Quality Assurance
QA ID	Quality Assurance Identification
QAM	Quality Assurance Manager
QAPP	Quality Assurance Project Plan
QMP	Quality Management Plan
QS	Quality System
SOW	Statement of Work
CRADA	Cooperative Research & Development Agreement

EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 4-100

☐ Other ☐ Amendment Number:

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-15-008	04/01/2015 To 03/31/2020 Base Option Period Number 4	R&E Methods Program Support

Contractor	Specify Section and paragraph of Contract SOW
JACOBS TECHNOLOGY INC.	Section 2.0

Purpose:
- [X] Work Assignment
- [ ] Work Assignment Amendment
- [ ] Work Plan Approval
- [ ] Work Assignment Close-Out
- [ ] Incremental Funding

Period of Performance: From 04/01/2019 To 03/31/2020

Comments:

Work Plan due 4/29/19.

No work, including but not limited to preparation of the Work Plan, shall begin until 4/1/19.

☐ Superfund — Accounting and Appropriations Data — [X] Non-Superfund

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

SFO (*Max 2*) ☐

Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code
1										
2										
3										
4										
5										

Authorized Work Assignment Ceiling

Contract Period:	Cost/Fee:	LOE:
04/01/2015 To 03/31/2020		
This Action:		
Total:		

Work Plan / Cost Estimate Approvals

	Cost/Fee	LOE:
Contractor WP Dated:		
Cumulative Approved:	Cost/Fee	LOE:

Work Assignment Manager Name: Robert Vanderpool (Signature) (Date)	Branch/Mail Code: Phone Number: 919-541-7877 FAX Number:
Project Officer Name: Robin S. Harris (Signature) (Date)	Branch/Mail Code: Phone Number: 919-541-0955 FAX Number:
Other Agency Official Name (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:
Contracting Official Name: Keith Pfeffer (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:

Performance Work Statement

WA Title: Reference & Equivalent Methods Program Support

WA #: 4-100 WACOR: Robert Vanderpool

Contract #: EP-C-15-008 Alternate WACOR: Jonathan Krug

PERIOD OF PERFORMANCE

The period of performance detailed in this Performance Work Statement (PWS) shall be from April 1, 2019 through March 31, 2020. This work assignment is a continuation of work assignment 3-100.

SUMMARY OF OBJECTIVES

By agreement with the Office of Air Quality Planning and Standards (OAQPS), the National Exposure Research Laboratory (NERL) of the Office of Research and Development (ORD) provides research and development of new air monitoring methods and associated quality assurance procedures in connection with new or existing national ambient air quality standards (NAAQS). Research and technical support to NERL's Reference and Equivalent Methods Program is needed which will include: (1) development and/or revision of Federal reference methods; (2) technical review and evaluation of formal applications received by EPA for reference and equivalent method determinations under 40 CFR Part 53 as amended December 18, 2006; (3) technical support related to the operation, performance, and quality assurance of existing reference or equivalent methods and their implementation in national air monitoring networks; and (4) research on new measurement technologies.

BACKGROUND

The Reference and Equivalent Methods Designation Program is carried out by the ORD in support of the OAQPS compliance air monitoring program to implement the national ambient air quality standards under regulations at 40 CFR 50 and 58. NAAQSs are currently established for six pollutants: SO_2, NO_2, O_3, CO, Pb, and particulate matter (PM_{10}, $PM_{2.5}$ and $PM_{10\text{-}2.5}$). By agreement with the OAQPS, the National Exposure Research Laboratory and ORD provide (a) the necessary research for the development of new Federal reference methods (FRMs) for ambient air monitoring coincident with the establishment of new NAAQSs, (b) development of reference and equivalent method designation requirements associated with new FRMs, (c) primarily technical and associated administrative services to evaluate and process applications for reference and equivalent method determinations and related activities under regulations at 40 CFR 53, as amended December 18, 2006, (d) research, investigation, and (if required) development of remedial techniques to resolve technical or implementation issues that may arise in the use of designated reference and equivalent methods in OAQPS's ambient air surveillance networks, and (e) development of new quality assurance procedures in connection with new or existing NAAQSs. The Air Quality Branch (AQB) of NERL is currently responsible for administering this program.

SCOPE

The contractor shall carry out activities related to the processing and technical evaluation of reference or equivalent method applications under EPA regulations at 40 CFR 53, as revised December 18, 2006. The various activities that are required under this task are described in the "Reference and Equivalent Methods Program and Procedures Handbook" (RTI/7490/042–2D), May 2007. The contractor shall carry out only those tasks identified as not inherently governmental in nature.

TECHNICAL APROACH/OBJECTIVES

Task 1. Technical Evaluation of Reference and Equivalent Method Applications

The specific task requirements for evaluation of each reference or equivalent method application may vary somewhat depending upon the specific circumstances of the particular application, which cannot be known until the application is received. In order to meet the 120-day regulatory deadline to respond to applications, the contractor shall evaluate and process each application expeditiously and in all cases shall complete the work not more than 110 calendar days after assuming custody of the application documents. In cases where additional information pertinent to a pending application is received subsequent to the first application review, the contractor shall continue the review activities to consider the new information, with an appropriate extended due date. To accommodate these conditions, the WACOR will notify the contractor of each application or modification request received. This written notification will identify the application to be evaluated, specify any minor deviations in the evaluation protocol for the application, and identify the date by which the deliverable(s) shall be provided to the WACOR.

The actual number of applications to be processed and the dates on which they will be received and available for processing is not known. However, it is assumed that evaluation of up to eleven (11) applications shall be required during the course of this Work Assignment. The contractor shall process applications as soon as practicable such that processing of any application is not unduly delayed by the processing of any other application. Technical evaluation and processing of requests for approval of modifications to existing reference or equivalent methods or similar requests shall be processed similarly, as appropriate to the nature of the request, with necessarily shorter completion times appropriate to the shorter regulatory deadline (90 days) for such requests. Any application materials identified as confidential business information (CBI) shall be treated in accordance with CBI regulations and policy restrictions.

Task 2. Investigation of Technical Issues

In support of the Reference and Equivalent Methods Designation Program, the contractor shall conduct laboratory and/or field tests and/or other research activities, as appropriate or necessary, related to the investigation and resolution of potential measurement anomalies, interferences, or other technical deficiencies associated with samplers, analyzers, measurement principles or techniques used in designated reference or equivalent methods or related to a pending application. The contractor shall also conduct laboratory and/or field tests in support of the

development and/or evaluation of new or existing methods in support of air pollution monitoring. The contractor's work plan shall anticipate up to three (3) such investigations of modest scope. When such a support need arises, the WACOR will notify the contractor and provide information regarding the technical question or issue to be investigated, the scope of the investigation, and the nature of the deliverable needed. If the nature of the issue is such that the scope of the investigation and/or its resolution will require substantial labor hours and cost beyond ten percent (10%) of the amount in the approved work plan, the contractor, upon receiving such a technical directive, shall immediately contact the WACOR with a copy to the Contract Level COR (CL COR). After a technical meeting with the WACOR, either an amendment to the work assignment will be issued or a revised technical memo and cost estimate shall be submitted for review and approval through the CL COR, WACOR, and Contracting Officer (CO).

Task 3. Technical Support for ORD's E485-A Environmental Weighing Chamber

ORD owns and operates a temperature and relative humidity controlled weighing chamber in E485-A for the gravimetric analysis of collected aerosol samples. This chamber is also used for the equilibration of filters prior to and following their field use. Mechanical components of the chamber include the air handling system, dehumidifier, steam unit, and electronic control equipment to ensure that the chamber operates at its 22° C and 35% Rh setpoints. The chamber also contains a robotic filter weighing system for the automatic gravimetric analysis of 35 mm and 47 mm diameter filters. EPA's Office of Air and Radiation annually funds a maintenance contract to handle component repairs of the weighing chamber.

The contractor shall routinely monitor and assess the overall functionality of the E485-A environmental weighing chamber to ensure that all key components are functional and that the temperature and relative humidity setpoints of the chamber are achieved. If performance problems are noted, the contractor shall contact the WACOR and provide details of the noted problems. The contractor shall also suggest corrective actions which are necessary to repair the faulty components. Any corrective actions performed shall first be approved by the WACOR and then carried out by using established methods and/or equipment manuals as needed. On a monthly basis, the contractor shall provide a brief operational report to the WACOR which documents the chamber's current operational status, describes the nature of any problems noted with the system's components, and describes any corrective actions which have been taken. On an as-needed basis, the WACOR will request that the contractor provide an update on the chamber's current operational status, report any scheduling problems associated with robotic system's use, and provide a current update on the status of any necessary repairs to the system's components.

Task 4. Attendance at Two National Air Monitoring Conferences

Manufacturers of Reference and Equivalent Method instruments regularly attend national air monitoring conferences to market newly developed and commercially available air quality monitoring instruments. During 2019, the AWMA Measurements Conference (Durham, NC; April 2 -4) and the AAAR Annual Conference (Portland, OR; Oct. 14-18) are the two primary air monitoring conferences of this type. The contractor shall attend both of these conferences and

conduct a survey of the manufacturers to learn which methods development efforts are being anticipated, under active development, or have been completed.

QUALITY ASSURANCE (QA)

Requirements stated in ORD Policies and Procedures Manual 13.2, Scientific Recordkeeping: Paper, for maintaining research notebooks shall be employed.

The contractor shall follow the protocols and standard operating procedures (e.g., calibration and operation of scientific instruments) as described in the Quality Assurance Project Plan (QAPP) "Reference and Equivalent Methods Program Support", QAPP-1J16-009.0. This QAPP shall be revised to reflect plans for current tasks described in this PWS and shall be submitted by July 31, 2019 to the EPA QAM for review/approval prior to the start of work. Specific guidelines to complete the technical evaluation of reference and equivalent method applications are found in the "Reference and Equivalent Methods Program and Procedures Handbook" (revised May 2007).

DELIVERABLES

Work Plan. A work plan containing a cost estimate shall be provided to the Contracting Officer (CO), CL COR, and WACOR in accordance with the work assignment cover page.

Task 1. Technical Evaluation of Reference and Equivalent Method Applications.

Results from the reviews of reference and equivalent methods shall be provided in the form of spreadsheets and Word documents. Both hard copy and electronic formats of results shall be provided.

Task 2. Investigation of Technical Issues

The contractor shall provide a written report with results of each Technical Issue investigated.

Task 3. Technical Support for ORD's E485-A Environmental Weighing Chamber

The contractor shall provide a written status report of the weighing chamber's functionality as part of the Monthly Report.

Task 4: Attendance at Two National Air Monitoring Conferences

At the end of each conference, the contractor shall provide a written report of the conducted survey of instrument manufacturers.

SCHEDULE of DELIVERABLES

Work Plan: In accordance with the work assignment cover page.

Task 1: As indicated in each Technical Directive issued.

Task 2: Delivery Date: 3/31/2020.

Task 3: Monthly status reports.

Task 4: Within one month of the completion of each conference.

EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 4-124

☐ Other ☐ Amendment Number:

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-15-008	04/01/2015 To 03/31/2020 Base Option Period Number 4	See attached PWS

Contractor	Specify Section and paragraph of Contract SOW
JACOBS TECHNOLOGY INC.	Section 5.2

Purpose:
- [X] Work Assignment
- [ ] Work Assignment Amendment
- [ ] Work Plan Approval
- [ ] Work Assignment Close-Out
- [ ] Incremental Funding

Period of Performance: From 04/01/2019 To 03/31/2020

Comments:

Work Plan due 4/29/19.

No work, including but not limited to preparation of the Work Plan, shall begin until 4/1/19.

☐ Superfund — Accounting and Appropriations Data — [X] Non-Superfund

SFO (*Max 2*) ☐

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code
1										
2										
3										
4										
5										

Authorized Work Assignment Ceiling

Contract Period:	Cost/Fee:	LOE:
04/01/2015 To 03/31/2020		
This Action:		
Total:		

Work Plan / Cost Estimate Approvals

Contractor WP Dated:	Cost/Fee	LOE:
Cumulative Approved:	Cost/Fee	LOE:

Work Assignment Manager Name: Karen Bradham (Signature) (Date)	Branch/Mail Code: Phone Number: 919-541-9414 FAX Number:
Project Officer Name: Robin S. Harris (Signature) (Date)	Branch/Mail Code: Phone Number: 919-541-0955 FAX Number:
Other Agency Official Name: (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:
Contracting Official Name: Keith Pfeffer (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:

Performance Work Statement

WA Title: **Inorganic laboratory support for soil bioavailability**

WA #: 4-124 WACOR: Karen Bradham

Contract #: EP-C-15-008 Alternate WACOR: Karen Herbin-Davis

Note: This work assignment PWS consolidates two previous work assignments (WAs) (3-120 and 3-124) into one single WA.

PERIOD OF PERFORMANCE

The period of performance detailed in this Performance Work Statement (PWS) shall be from April 1, 2019 through March 31, 2020.

SUMMARY OF OBJECTIVES

The purpose of this Work Assignment (WA) is to provide laboratory support related to assessing the bioavailability and bioaccessibility of inorganic contaminants in soil, dust, biological tissues, and other environmental matrices. Laboratory support includes preparation and analysis of standards and samples and associated recordkeeping, including:

1. Analysis of samples for total metal concentration by ICP-MS and ICP-OES
2. Acid extraction/digestion of samples to assess the bioaccessibility and bioavailability of soil and dust inorganics and analysis of relevant soil properties that influence bioaccessibility (soil pH, carbonate content, etc)
3. Acid washing of glassware
4. Sieving of soil and dust samples
5. Procurement of laboratory supplies as needed to support tasks 1-4 above
6. Developing new or revising existing standard operating procedures (SOPs) as needed
7. Providing QA review of ICP-MS and ICP-OES data and preparing data reports
8. Assistance with writing of technical manuscript(s) for publication in peer-reviewed journals related to bioavailability of inorganic metals
9. Develop or refine statistical model (in the form of simulation study) using R to explore propagation of uncertainty when using metal bioavailability estimates to adjust site-specific metal concentration at contaminated sites
10. Bioavailability data/database management

BACKGROUND

Assessing the bioavailability of inorganic contaminants in soil, dust and similar matrices involves the quantification of elemental totals and biologically-relevant extractable fractions in the matrix of interest. These data and methods provide reliable information needed to evaluate human exposures to these elements.

SCOPE

In collaboration with the EPA WACOR and EPA employees designated by the EPA WACOR, the Contractor shall:

Task 1: Analyze samples for total metal concentration by ICP-MS and ICP-OES

- Analyze samples, including in vitro bioaccessibility extracts, water samples, and mouse tissue samples, for total element concentration by ICP-MS and ICP-OES. The WACOR will provide access to ICP-MS and OES instrumentation, and reagents and consumables necessary to operate the instrument.
- Operation of the ICP-MS shall be in accordance with the following SOPs:
    - D-EMMD-PHCB-024-SOP-01 (MDAB 091.0) - Operation and Maintenance of the Thermo X-Series 2 Inductively Coupled Plasma Mass Spectrometer
    - D-EMMD-PHCB-025-SOP-01 (MDAB 092.0) - Determination of metals in soil extracts via ICP-MS in accordance with EPA Method SW-846 6020A
    - D-EMMD-PHCB-SOP-3459-0 - Analysis of lead and other inorganic elements in drinking water by ICP-MS
- Operation of the ICP-OES shall be in accordance with the following SOPs
    - D-EMMD-PHCB-026-SOP-01 (MDAB 093.0) - Operation and Maintenance of the Thermo iCAP 6500 Duo ICP-OES Spectrometer

Task 2: Acid extraction/digestion of samples to assess the bioaccessibility and bioavailability of soil and dust inorganics and analysis of relevant soil properties that influence bioaccessibility (soil pH, carbonate content, etc.)

- In vitro extraction testing to evaluate the bioaccessibility of select inorganic elements, including but not limited to lead and arsenic, in residential soil and dust in accordance with EPA Method 9200.2-86 and relevant standard operating procedures provided by the EPA WACOR.
- Microwave assisted acid digestion of soils, dusts and biological tissues in accordance with EPA Method 3051A and relevant standard operating procedures provided by the EPA WACOR.
- Maintaining laboratory notebook, records, and inventories of laboratory supplies.

Task 3: Acid washing of glassware

- Acid washing of glassware in accordance with standard operating procedures provided by the EPA WACOR.

Task 4. Sieving of soil and dust samples

- Sieving, homogenizing and sub-sampling of soil and dust samples in accordance with standard operating procedures provided by the EPA WACOR.

Task 5. Procurement of laboratory supplies as needed to support tasks 1-4 above

- Procure laboratory supplies (lab consumables and chemicals) to assist in successful completion of tasks 1-4 above. All lab procurements shall be approved by the EPA WACOR prior to initiation of purchase by the Contractor.

Task 6: Developing new or revising existing inorganic SOPs in collaboration with the EPA WACOR or WACOR designees as needed to complete Tasks 1-4.

- Revise SOPs in collaboration with the EPA WACOR or designees as needed to successfully complete tasks 1 and 2.

Task 7. Providing QA review of ICP-MS and ICP-OES data and preparing data reports

- Review ICP-MS and ICP-OES data generated from task 1 and ensure data meets QA/QC objectives as stated in the relevant SOPs or as designated by the EPA WACOR.

Task 8. Writing of technical manuscript(s) for publication in peer-reviewed journals related to bioavailability of inorganic metals.

- Assist the EPAWACOR with the writing, co-authorship, technical editing and formatting of manuscripts on bioavailability of inorganic metals research and exposure assessment and remediation of metal contaminated soils.

Task 9. Refine statistical model (in the form of simulation study) using R to explore propagation of uncertainty when using metal bioavailability estimates to adjust site-specific metal concentration at contaminated sites.

- Assist the EPA WACOR in the refinement of existing R code that uses simulation study to explore uncertainty in use of % bioavailability estimates to adjust site-specific soil metal exposure levels. Explore how soil sampling and analysis methods can influence uncertainty.

Task 10: Bioavailability database management

- Assist the EPA WACOR with management of bioavailability data associated with tasks above using Microsoft Word, Excel and OneNote or similar software.

While exact numbers of samples to be prepared, extracted and analyzed (and associated data summary reports) is unknown in advance, it is anticipated that approximately 5,200 hours of work shall be necessary to successfully complete the tasks above, with work spread out evenly throughout the performance period.

Technical Approach

Laboratory samples (including soil, dust, and biological samples) and associated QA/QC samples shall be prepared, extracted and analyzed following relevant EPA methods and standard operating procedures previously described.

INSTRUMENTATION/EQUIPMENT EXPECTATIONS

All laboratory equipment necessary to complete these tasks, including ICP-MS, ICP-OES, in vitro soil bioaccessibility extraction device, microwave digestion unit(s), and soil characterization equipment will be made available by the EPA WACOR or WACOR designees.

The Contractor shall coordinate use of equipment with the EPA WACOR or WACOR designees, as instruments are routinely in use by other laboratory personnel. Chemical standards and consumables (such as sample tubes, pipette tips, etc.) will also be provided by the EPA WACOR or WACOR designees. However, procurement of additional chemical standards and consumables may be necessary for successful completion of WA tasks. If needed, procurement of standards and consumables shall be approved by the EPA WACOR prior to initiation of purchase by the Contractor.

QUALITY ASSURANCE

The Contractor shall use the existing EPA-approved Category B QAPP for the Toxic Element Bioavailability Laboratory (D-EMMD-PHCB-003-QAPP-02) for quality control and assurance. In particular, Section 4. Experimental Design describes extraction and digestion methods and analytical analysis for soil and biological samples, and Section 5. Quality Assurance/Quality Control describes QA objectives. Table 1 of the QAPP summarizes relevant SOPs (which include additional QA objectives specific to that SOP) associated with laboratory methods described in this PWS. The QAPP may be amended by the WACOR to include additional project personnel. EPA will also provide amendments to the existing QAPP for use by the Contractor to cover work described in this PWS as directed (e.g., an amendment covering statistical regression model and synthetic study development for soil metal bioavailability).

DELIVERABLES

Deliverables	Schedule
Data summary reports	Provided as data becomes available (at a minimum monthly) throughout performance period
Monthly report describing lab work conducted	Provided monthly throughout performance period
Revisions to standard operating procedure(s)	As requested by the EPA WACOR, revisions to SOP(s) shall be provided within one month of request.
Manuscript development support	As requested by the EPA WACOR, writing and/or technical editing of manuscripts or reports associated with tasks described in this PWS shall be provided within one month of request.

EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 4-125

☐ Other ☐ Amendment Number:

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-15-008	04/01/2015 To 03/31/2020 Base Option Period Number 4	See attached PWS

Contractor: JACOBS TECHNOLOGY INC.

Specify Section and paragraph of Contract SOW: Section 2, 6, 7

Purpose:
- [X] Work Assignment
- [ ] Work Assignment Amendment
- [ ] Work Plan Approval
- [ ] Work Assignment Close-Out
- [ ] Incremental Funding

Period of Performance: From 04/01/2019 To 03/31/2020

Comments:

Work Plan due 4/29/19.

No work, including but not limited to preparation of the Work Plan, shall begin until 4/1/19.

☐ Superfund — Accounting and Appropriations Data — [X] Non-Superfund

SFO (*Max 2*) ☐

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code
1										
2										
3										
4										
5										

Authorized Work Assignment Ceiling

	Cost/Fee	LOE
Contract Period: 04/01/2015 To 03/31/2020		
This Action:		
Total:		

Work Plan / Cost Estimate Approvals

	Cost/Fee	LOE
Contractor WP Dated:		
Cumulative Approved:		

Work Assignment Manager Name: Vasu Kilaru (Signature) (Date)	Branch/Mail Code: Phone Number: 919-541-5332 FAX Number:
Project Officer Name: Robin S. Harris (Signature) (Date)	Branch/Mail Code: Phone Number: 919-541-0955 FAX Number:
Other Agency Official Name: (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:
Contracting Official Name: Keith Pfeffer (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:

Performance Work Statement

WA Title: Sensor Loan Program and Sensor Evaluation Technical Support

WA #: 4-125 WACOR: Vasu Kilaru

Contract #: EP-C-15-008 Alternate WACOR: TBD

PERIOD OF PERFORMANCE

The period of performance detailed in this PWS shall be from April 1, 2019 through March 31, 2020.

SUMMARY OF OBJECTIVES

This work assignment shall provide follow-on field and laboratory technical support for **four** main projects.

1 - The first project, entitled "Sensor Pod Loan Trial for Investigating Regional and Community Air Pollution", is a collaboration between the Environmental Protection Agency's Office of Research and Development (EPA/ORD) and multiple EPA Regions. Herein, this project shall be referred to as the "Sensor Loan Program".

The overall goal of the sensor loan program from EPA/ORD's perspective is to evaluate the practical and technical aspects of a sensor pod loan program. Specific objectives: 1) better understand regional needs and prospective applications of low-cost sensor technologies; 2) estimate the costs (both direct and indirect) associated with developing a larger scale sensor loan program; 3) determine the robustness of sensor pods and calibrations through repeated deployments in meteorologically contrasting locations and seasons; 4) gauge the effectiveness of training and guidance documents in helping to guide regional partners; 5) evaluate the extent to which regions can independently conduct field campaigns to answer regionally relevant questions. Results of these evaluations shall be used to guide improvements to guidance materials.

2 - The second project is a continuation of emerging low-cost air quality sensor evaluations previous conducted under WA 1-115, 2-125, and 3-125. Herein, this project shall be referred to as "Sensor Evaluation".

The overall goal of the sensor evaluation work is to assess the performance of a variety of new air quality sensors compared to reference grade (FRM, FEM, or other as defined by the WACOR) measurements. Specific objectives: 1) identify popular or promising new devices for measurement of one or more NAAQS pollutants; 2) conduct an initial performance evaluation to determine the robustness and usefulness of the device through collocation of triplicate sensors at the AIRS platform; 3) report the evaluation findings to inform other users or potential users of the evaluated device; 4) if warranted, conduct further performance evaluation of the device in laboratory or field environments.

3 - The third project, entitled "Long-Term Ambient Air Quality Sensor Performance Evaluation", is an investigation of the long-term performance of air quality sensors under various

conditions in six different locations within the continental US. Herein, this project shall be referred to as the "Long-Term Performance Project".

The overall goal of the long-term performance project is to evaluate the change in performance of sensors under a variety of ambient conditions as they age. Specific objectives: 1) identify three of the most popular sensor technologies in use today; 2) identify approximately 6 regulatory monitoring sites in distinctly different environments within the continental US that are running the same types of FRM/FEM instruments and are measuring all of the same pollutants as the chosen sensors; 3) deploy the same set of sensor types at each of the regulatory monitoring sites where local personnel operate them for a period of 9 months to not more than 1 year collecting data weekly; 4) compare the sensor data to the collocated reference data to monitor for degradation in the agreement between the measurements and to determine the rate of degradation; 5) determine how the rate of degradation in the agreement is influenced by the local environmental conditions (meteorology or pollutant concentrations).

4 - The fourth project, entitled "Air Sensors Lab Design", is the development of a design document for the air sensors laboratory. Herein, this project shall be referred to as the "Lab Design".

The overall goal of the lab design project is to develop a laboratory design document containing 1) vendors, part numbers, price quotes, and specifications for the commercial equipment and components complete with specifics including tubing and fittings, 2) design and fabrication documents for components that should be built or changes that should be made to the lab infrastructure, 3) and renderings of the final integrated design needed to build out the air sensors lab. The design document shall prioritize function but shall also consider the most cost-effective ways of meeting evaluation needs.

BACKGROUND

Recent advances in air pollution monitoring technology have led to the development of sensors that are much smaller and lower in cost than traditional ambient air monitoring systems. One of the potential benefits of smaller, less expensive sensors is the ability to deploy a larger number of them across a small geographic area (e.g. a neighborhood) to collect data with a level of spatial and temporal resolution that is neither available nor feasible using traditional regulatory quality monitoring methods.

Additionally, the small size and cost allow multiple sensors to be combined into a single device (pod), providing the ability to monitor multiple pollutants simultaneously with a single device. The sensor loan program will use such a device to give EPA Regions access to cutting edge sensor technology to investigate local and regional air quality while relieving them of the technical burdens and maintenance aspects of having to develop a similar capability.

Manufacturers are continuing to develop user-friendly and field deployable devices to measure a single pollutant or multiple pollutants. These devices are useful for EPA and other researchers to achieve research goals that include community-level air monitoring. Additionally, these devices are attractive tools for communities to conduct their own air monitoring. Thus, EPA needs more

information about their performance to properly interpret and respond to the data being produced by these devices. The sensor evaluation work will focus on products with high potential for use by communities, citizen groups, and others.

EPA's sensor evaluation work has traditionally relied on field collocation near reference-grade instruments to evaluation sensor performance. This technique will be relied upon heavily during this WA but, plans are needed to outfit the air sensors laboratory (D 566A-EPA/RTP campus) with the capability to conduct sensor evaluations under controlled conditions. Adding this capability will allow EPA to test sensors under conditions that are not readily available in the RTP area including ultra-low and high conditions, a wider range of relative humidity and temperature conditions, etc. in the future.

SCOPE

The sensor loan programs shall be conducted under multiple tasks that accomplish the following:

1. Complete purchase of 20 multi-pollutant sensor pods from Aerodyne Research.
2. Prepare sensor pods for field deployment and evaluation.
3. Evaluate the sensor pods via collocation with reference monitors at the Air Innovation Research Site (AIRS) on the EPA RTP campus.
4. Track and ship sensor equipment being loaned to regional partners.
5. Inspect, repair, and evaluate via short collocation at AIRS between loans.

The sensor evaluations shall be conducted under several tasks that accomplish the following:

1. Purchase, prepare, and deploy up to 10 additional air quality sensors or multi-pollutant sensor pods for collocation evaluation at the AIRS platform.
2. Finish preparation of a written report documenting the details of the collocation evaluations conducted during the last option period and any new evaluations conduced during this option period.

The long-term performance project shall be conducted under multiple tasks that accomplish the following:

1. Finish procurement of sensors and preparation of operational SOPs.
2. Secure local operators for the field locations who will deploy, support, and download data from each of the sensors.
3. Conduct training for local operators and other partners.
4. Package, track, and ship sensors to local operators.
5. Receive, compile, and review data from the sensors and collocated reference monitors.
6. Prepare a written report documenting the details of this project including preparation activities, observations, lesson learned, recommendations, etc.

The lab design project shall require the Contractor to accomplish the following:

1. Finish development of a rendering of the design needed to build out the air sensors lab.

TECHNICAL APROACH/OBJECTIVES

The technical approach is divided into tasks. These tasks combined achieve the overall project objectives of supporting the sensor loan program and facilitating sensor evaluation.

For the sensor loan program, the WACOR will provide technical direction on the evaluation period and methods used before and between deployments and shipping address and length of loans for each regional deployment. For the sensor loan program and the long-term performance project, the contractor shall be responsible for tracking the sensors and components (ORD property). The contractor shall document all costs, observations made while carrying out each task, changes from documented procedure, and problems and their solutions. The contractor shall maintain all chain or custody and data records and supply those to the WACOR at the end of this work assignment.

For the sensor evaluation work, the WACOR will provide technical direction on the types and number of sensors purchased, the evaluation period and methods used. If needed, the contractor shall be responsible for properly handling this ORD property and shall ensure the WACOR always knows the location of property. This property shall be returned to the WACOR at the end of this work assignment. The contractor shall document all costs, observations made while preparing the sensors, deploying them to the AIRS platform, and in evaluating and analyzing the data. The contractor shall document all changes from documented procedures, and problems, troubleshooting efforts, and solutions. The contractor shall maintain laboratory and field notebooks that will be shared with and supplied to the WACOR at the end of this work assignment.

Task #1. Communication and Documentation

To assist the contractor in understanding the PWS for development of their cost estimate, a kick-off meeting shall be held within one week of the WA initiation date. This kick-off meeting shall be attended by key contractor personnel anticipated to be involved in work and the EPA WACOR.

Following the kick-off meeting, the contractor shall participate in bi-weekly meetings established by the WACOR to provide updates on project tasks and to discuss any technical or other issues that have arisen.

In support of research objective #2 of the sensor loan program, the contractor shall develop a monthly report which details a brief status update, direct cost expenditures, and hours expended per person for each task.

The contractor shall keep research notebook(s) (paper, electronic, or both) documenting details of all work done for each task. The contractor shall take all available laboratory notebook training (contact NERL/EMMD/SSAB QA Manager Christine Alvarez) and shall comply with all EPA-specific laboratory notebook protocols. The contractor shall share electronic notebooks with the WACOR throughout the project according to procedures provided in technical direction. A paper research notebook may also be maintained and would be especially useful for field

activities at AIRS. The contractor shall deliver all paper notebooks and all chain of custody and shipment documentation to the WACOR at the conclusion of this work assignment.

The contractor shall provide data, as well as associated field notes, observations, and troubleshooting efforts, to the WACOR within 24 hours of data download and/or transmittal. All data download activities shall be maintained within the research notebook.

The contractor shall develop an EPA report documenting the details of the work done in support of the sensor evaluation efforts (Task 5) and a separate report detailing the support, sensor siting, and operation of the sensors deployed for the LTPP (Task 4). The WACOR will provide an example document and template to guide the development of the report. Personnel with technical writing experience shall best be able to achieve the level of detail and writing quality needed to develop this report. Draft reports for the sensor evaluation work (Task 5 plus collocation results for loaned sensors used in the Regional Sensor Loan Project) are due September 30, 2019 and January 31, 2020. A final report is due March 31, 2020. Draft reports for the long-term sensor performance work (Task 4) are due July 31, 2019 and December 2, 2019 with a final report due March 31, 2020.

Task #2. ARISense Pod Purchase and Preparation

The contractor shall complete the purchase of 26 ARISense multi-pollutant sensor pods from Aerodyne Research initial ordered during Option Period 3. 20 pods shall support the Regional Sensor Loan Program and 6 shall support the Long-Term Performance Project. All sensor pods shall be capable of running on AC power with seven (7) equipped to also run on solar power with battery backup. The contractor shall work with EPA to enter the devices into the property control database and tag the equipment. The contractor shall label all sensor pod components, according to technical direction, to keep the components for each sensor pod together.

The contractor shall develop a Standard Operating Procedure (SOP) that is suitable for use by Regions and their community. EPA shall review the document and the contractor shall edit these procedures to address all comments and concerns provided by the WACOR and shall be approved by EPA before beginning collocation evaluation.

Following SOP approval, the contractor shall conduct field collocation evaluations of the pods via collocation with reference monitors at AIRS. Simultaneous collocation is preferred. If necessary, the contractor shall collocate the pods in two batches, one containing 20 sensor pods and the other containing 6. The contractor shall perform sensor collocation evaluation according to the existing Quality Assurance Project Plan (QAPP) #D-EMMD-0031530-QP-1-0. EPA will provide space, power, and access to the AIRS platform. The length of this collocation evaluation will be specified by technical direction in consideration of the loan schedule but shall last at least 4 weeks. **This initial collocation effort shall also be considered an evaluation and details shall be included in the evaluation report (Task 5).** The contractor shall ready the AIRS site with any necessary supporting equipment in advance of field deployment (power cords, mounting poles, etc.). Following formal evaluation, the contractor shall update the SOP if needed and according to technical direction.

Task #3. Sensor Loan Project Support

The WACOR will provide the contractor with all details necessary for loaning the pods to the participating EPA Regions (i.e., which pods and power requirements, how many, where, when, for how long). The contractor shall securely box the sensors and all peripheral components to minimize the possibility of damage in transit using pelican style hard cases with customizable form inserts, the design of which shall be approved by the WACOR. The contractor shall purchase peripheral equipment to support the devices including USB power port hubs to charge batteries (7x4 = 28 USB ports available). The contractor shall arrange for the shipment or delivery of pods with tracking to and from Regional partners in the most cost-effective manner possible according to the schedule specified by the WACOR in technical direction. Expedited shipping shall require justification and WACOR approval. A method for tracking the location of each sensor pod and for maintaining a chain of custody shall be proposed and approved by the WACOR and strictly adhered to by the contractor.

Should any pods fail to function during a deployment, the contractor shall remotely assist with non-evasive troubleshooting efforts and/or arrange for the malfunctioning pod to be returned for inspection and repair. **Observations and efforts shall be included in the evaluation report (Task 5).**

After each Regional deployment, the contractor shall coordinate return of the loaned sensor equipment, including scheduling pickup and shipping of the sensors. Within three (3) calendar days of return, the contractor shall inspect the returned shipment, inventory all components, and inspect for damage. The contractor shall immediately notify the WACOR about missing components or damage. If needed and specified by technical direction, the contractor shall arrange for repair of any damaged equipment through the commercial vendor, though possibly some repairs could be performed in-house after consulting with the vendor.

Within 1 week of return, from the region or from repair (if needed), the contractor shall perform a collocation evaluation of the sensors at AIRS to confirm acceptable performance before the equipment is loaned out for another deployment. The length of this collocation evaluation shall be specified by technical direction in consideration of the loan schedule but shall last at least 2 weeks. **These short collocation effort observations shall also be included in the evaluation report (Task 5).**

Task #4. Long-Term Performance Project Support

The contractor shall complete preparation of 6-9 copies of 6 sensor types (Purple Air, APT Maxima, Sens-it RAMP, Aerodyne Research ARISense, Aeroqual AQY, and Clarity Node). This shall involve finishing acquisition (if outstanding from WA 3-125), acceptance of loaned equipment (CRADA, MTA, or EPA acquisition), and benchtop operational testing. If necessary, the contractor shall work with EPA to enter the devices into the property control database and tag the equipment. Sensors that consist of multiple components shall be further labeled, according to technical direction, to keep the components for each sensor system together.

The contractor shall immediately identify local technicians to support 4 of the 6 identified field sites (DE, GA, OK, CO). The local technician shall be technically knowledgeable of air quality and instrumentation. Each local technician shall be responsible for attending training, receiving the sensors, deploying them at the field site near federal reference monitors in coordination with the site contact, for manually recovering the data at least weekly (as needed), for emailing those files to the WACOR and contractor staff, and for monitoring the routine operation of the sensors. The local technician shall maintain sensor operation and time check notes using log sheets designed and provided by the contractor. Should any sensor fail to function during a deployment, the contractor shall assist with troubleshooting efforts and, if necessary, arrange for the malfunctioning sensor to be returned for inspection and repair.

The state/local agency technical point (site owner), local technician, or contractor shall also be responsible for recovering the nearby reference and meteorological data at the highest time resolution available (1-minute preferred) at least monthly; the person responsible shall be determined independently by site and detailed in the Long-Term Performance Project QAPP. The contractor shall be responsible for following up with the local staff should data not arrive on the agreed upon schedule, reviewing the data as it comes in to monitor for sensor malfunction, and compiling the data (sensor and reference) into a shared project folder for access by both contractor and EPA staff. The contractor shall maintain notes pertaining to observations (regarding sensor operation and/or data). The data files shall be maintained in a shared file location (O: drive) for regular access.

Following preparation, the contractor shall deploy the sensors for a short period in the filter weight room and for a collocation period at AIRS to verify operational status and to check for abnormal performance. The length of these evaluations shall be specified by technical direction but shall last at least 3 days in the filter room and at least 2 weeks (longer better) at AIRS. This data also provides a comparison for how the sensors compared prior to remote deployment. The contractor shall verify operational status of the sensors daily to identify and resolve any problems as quickly as possible. If necessary, the contractor shall consult with the manufacturer to permanently resolve any issues. The contractor shall keep field notes in the assigned research notebook. EPA will provide space, power, and access to the AIRS platform for this test. The contractor shall ready the AIRS site with any necessary supporting equipment in advance of field deployment (power cords, mounting poles, etc.). The chicken coop structure already in position at the AIRS site shall be available to support the field deployment, if needed. The contractor shall deploy all copies of a sensor device at the same time. The contractor shall recover data from the sensors on at least a weekly basis and shall provide the data to the WACOR within 24 hours of download.

The short collocation period provides an ideal opportunity for training remote local operators. The contractor shall video record a demonstration of the setup, operation, and data download of each of the sensors. The local technical staff identified by the contractor shall be brought to the RTP campus for training on field operations including the setup, routine operation, data download, and data transmission as well as any potential troubleshooting they may be asked to do. For cost estimation purposes, the contractor shall assume one field operator will be trained

for each field site. The contractor shall be available for remote audio and visual support as local operators install the sensor equipment at the field sites and during troubleshooting.

Once the WACOR is satisfied with all aspects of the sensor operations (operation, preparation, etc.), the WACOR will issue technical direction for 6 of each sensor type to be securely packaged and shipped to the field sites (if available, the remaining 3 will remain deployed at AIRS). The contractor shall maintain shipping and chain of custody records which shall be delivered to the WACOR before the end of the performance period. Before deployment, the contractor shall review the long-term performance project QAPP (#D-EMMD-0031862-QP-1-0) and the sensor SOPs to ensure they provide the correct project details and instructions necessary to support remote operation by the local operators. The contractor shall request amendment (seeking EPA approval) if needed.

The contractor shall provide a separate report for the long-term performance project which details the sensor preparation, siting, operation, and observations to the WACOR. Technical direction and the same example document and template provided for the sensor evaluation effort can serve as a guide the development of the report. Personnel with technical writing experience shall best be able to achieve the level of detail and writing quality needed to develop this report. Draft reports for the long-term sensor performance work are due July 31, 2019 and December 2, 2019 with a final report due March 31, 2020.

Task #5. Sensor Evaluation

The contractor shall support the collocation evaluation of a maximum of 10 sensor types, in triplicate as specified by technical direction. The sensors shall be commercial sensors or OEM sensors with data acquisition support (no expensive assembly required) and may be single pollutant or multi-pollutant sensor pods. For work plan cost estimation purposes, the contractor shall assume a retail cost of no more than $5,000 for all equipment purchased for evaluation.

The sensors shall be selected through Contractor-WACOR discussion and ultimately technical direction. This shall include evaluation of the APIS multi-pollutant sensor started under WA 3-125. Other examples include, but are not limited to, AQTreks PAM, PocketLab Air, Senserion PM sensor, uRAD city model, Air Quality Egg (newly updated), Kunak, Praxis, Libilium, SailHero, Lunar Outpost Canary, and Blue Tomorrow. Should sensors not on this list (e.g., AirVisual) be identified for evaluation, the WACOR will be responsible for amending the project QAPP. Equipment purchase shall begin as soon as possible after technical direction. If necessary, the contractor shall work with EPA to enter the devices into the property control database and tag the equipment. Sensors that consist of multiple components shall be further labeled, according to technical direction, to keep the components for each sensor system together.

Once a sensor is ready for field evaluation, the contractor either shall develop a SOP, using the EPA approved template, detailing the operation and data download procedures for the sensors or present a complete user manual that may be approved by EPA in lieu of the SOP. The contractor shall address all feedback from EPA and the SOP or manual shall be approved by EPA before beginning the formal evaluation period.

Following purchase, preparation, and document approval, the contractor shall conduct field evaluation of sensors via collocation with reference monitors. EPA will provide space, power, and access to the AIRS platform. The contractor shall ready the AIRS site with any necessary supporting equipment in advance of field deployment (power cords, mounting poles, etc.). The chicken coop structure already in position at the AIRS site shall be available to support the field deployment, if needed. The contractor shall deploy three copies of each sensor device at the same time. Subject to WACOR approval, the contractor may conduct the evaluation of the sensor devices in small batches. Evaluation of the final batch shall begin no later than January 15, 2020.

The contractor shall verify the operational status of the sensors daily to identify and resolve any problems as quickly as possible. The contractor shall keep field notes in the assigned research notebook. The contractor shall recover data from the sensors on at least a weekly basis and shall provide the data to the WACOR within 24 hours of download.

After an initial evaluation period and once the WACOR is satisfied with all aspect of the sensor operations, including data recovery and data quality, the WACOR will issue technical direction for a formal evaluation period of at least 30 days, up to 90 days. During this time, the contractor shall maintain the weekly data recovery frequency and 24-hour turn-around. Following evaluation, the contractor shall update the SOP and data processing solution as needed and according to technical direction.

The contractor shall provide details of the evaluation work (general information, preparation work, evaluation observations, troubleshooting/resolution details to issues encountered, and data observations and definitions (as necessary)) in an EPA report by the end of this WA. Report drafts due September 30, 2019 and January 31, 2020. A final report is due March 31, 2020.

Task #6. Air Sensors Lab Design

The Air Sensors lab (D566A) is an existing EPA laboratory space that has recently been re-assigned to be a hub for air sensor related work. EPA wishes to eventually outfit this space to include the capacity to conduct sensor evaluations, in triplicate, under controlled conditions including variable particle types and concentrations, gas types and concentrations, relative humidity, and temperature. The design shall include gas and particle generating, mixing, and delivery systems, an exposure chamber, a manifold system, reference analyzers, and exhaust plans. This design work shall address all aspects of the design to make these needs possible from specs for commercial components all the way down to a plan with the tubing and fittings needed to fully assemble such a system. This design shall also consider routine cleaning, maintenance and operation and thus shall design for easy monitoring and access to consumables and changeable features like valves and connections.

Under WA 3-125, the contractor created a scoping document, a draft drawing for the chamber design, a preliminary component list, and a list of questions to be answered by EPA facilities. The contractor shall finish this work by developing a final component list for the final design schematic. This list shall include the component name, vendor, part number, price quote, and any detailed specifications needed to purchase the equipment (including sole source justification,

if applicable). This list shall not only include the large commercial components (e.g., CAPS NO_2 analyzer) but the small components (e.g., tubing and fittings) that make up the entire system. The schematic shall also show how the components should be oriented and connected to make up the fully assembled system. Technical direction may be used to prioritize the component list based on EPA funding mechanisms. A second draft list shall be due 2 weeks after receipt of EPA comments and building facilities information. A final list shall be due 30 days after receiving EPA comments from draft #2.

The contractor shall consider and develop a document detailing questions and suggested changes for the lab infrastructure (e.g., reconfiguration of lab benches, new outlets, duct work) so that such changes can be discussed and ultimately requested from building facilities. If requested, the WACOR can facilitate a meeting between the contractor and facilities staff to discuss the necessary details. This work can be submitted on an ongoing basis and shall be addressed as soon as questions or suggestions arise to avoid assumptions that turn out to be false thus wasting time and effort.

The laboratory design shall prioritize function over cost, but, cost shall still be considered. If it makes sense for a component (e.g., a chamber, a manifold system) to be built in-house or re-purposed from another experiment, the contractor shall develop design documents so that technical staff can build or adapt the equipment needed. These designs shall be complete and specific allowing a technical staff person to quickly and easily quote and accomplish the job using appropriate materials.

All of the above-mentioned design documents (schematic, component list, sole source justifications, design documents) shall be compiled into a single technical report for easy reference. These design document in its entirety shall be delivered no later than 30 days after delivery of the final component list. Any necessary revisions following WACOR review shall be delivered within two weeks.

QUALITY ASSURANCE (QA)

The WACOR has revised the Air Sensor Evaluation QAPP so that the QA guidelines specified are all clearly defined within one document for easier reference. This QAPP is #D-EMMD-0031530-QP-1-0 titled, "Field Collocation of Air Quality Sensors with Reference Grade Instruments." This document shall govern all sensor evaluation efforts and the collocation of sensors pods used in the loan program while collocated at AIRS before and between loan periods.

Under WA 3-125, the contractor developed the "Air Quality Sensors - Long-Term Performance Project" QAPP (#D-EMMD-0031862-QP-1-0). This document is expected to be finalized early in WA 4-125 (prior to shipment of equipment to field locations) and shall govern the long-term performance project efforts.

EPA/ORD, in collaboration with the contractor, will modify these QAPPs on an as needed basis if additional quality requirements or changes are necessary.

DELIVERABLES and their Schedule

Task 1 Communication and Documentation

Deliverable 1.1. The contractor shall attend a kick-off meeting within two weeks of the WA effective date (4/1/2019).

Deliverable 1.2. The contractor shall participate in bi-weekly meetings established by the WACOR to provide updates on project tasks and to discuss any technical or other issues that have arisen.

Deliverable 1.3. The contractor shall keep research notebook(s) according to EPA protocols describing all work done for each task. Electronic notebooks shall be shared with the WACOR throughout the project. Paper notebooks shall be delivered to the WACOR no later than March 31, 2020.

Deliverable 1.4. The contractor shall provide all chain of custody and shipment documentation by March 31, 2020.

Deliverable 1.5. In support of research objective #2 of the sensor loan program, the contractor shall develop a monthly report, due the 15th of the following month, which details a brief status update, direct cost expenditures, and hours expended per person for each task.

Deliverable 1.6. The contractor shall provide data to the WACOR within 24 hours of data download and/or transmittal.

Deliverable 1.7. The contractor shall develop an EPA report documenting all the details and outcomes of the evaluation conducted under Task 5 plus the collocation results for sensors loaned for the Regional Sensor Loan Project. Report drafts due September 30, 2019 and January 31, 2020. A final report is due March 31, 2020.

Deliverable 1.8. The contractor shall develop an EPA report documenting the details of the long-term performance project (Task 4). Draft reports for the long-term sensor performance work are due July 31, 2019 and December 2, 2019 with a final report due March 31, 2020.

Task 2 Pod Purchase

Deliverable 2.1. The contractor shall complete the purchase 26 multi-pollutant sensor pods from Aerodyne Research initially ordered during Option Period 3. Delivery expected in early April but no later than April 30, 2019.

Deliverable 2.2. The contractor shall work with EPA to enter the devices into the property control database and tag the equipment within 30 days of receipt.

Deliverable 2.3. The contractor shall develop a SOP suitable to use by non-experts within 30 days of receipt.

Deliverable 2.4. The contractor shall conduct filter room tests and field evaluations of the pods via collocation with reference monitors lasting a minimum of 30 days and finishing within 50 days of the SOP approval.

Task 3 Sensor Loan Project Support

Deliverable 3.1. The contractor shall securely box the sensors in pelican style cases and arrange for the shipment of pods to and from Regional partners and shall maintain a chain of custody records.

Deliverable 3.2. The contractor shall purchase peripheral equipment to support the devices including USB power port hubs to charge batteries records.

Deliverable 3.3. Should any pod fail to function during a deployment, the contractor shall conduct remote troubleshooting and/or arrange for the malfunctioning pod to be returned for inspection and repair.

Deliverable 3.4. Within three (3) calendar days of return, the contractor shall inspect the returned pods, account for all components, inspect for damage, and arrange for any necessary repair.

Deliverable 3.5. Within 1 week of return, from the region or from repair (if needed), the contractor shall perform a collocation evaluation of the sensors at the AIRS station to confirm acceptable performance before the equipment is loaned out for another deployment.

Task 4 Long-Term Performance Project Support

Deliverable 4.1. The contractor shall complete preparation of 6-9 copies of 6 sensor types (Purple Air, APT Maxima, Sens-it RAMP, Aerodyne Research ARISense, Aeroqual AQY, and Clarity Node). When appropriate the contractor shall work with EPA to enter the devices into the property control database and tag the equipment.

Deliverable 4.2. The contractor shall immediately identify local technicians to support 4 of the 6 identified field sites (DE, GA, OK, CO). The local technician shall be responsible for deployment, site visits, data recovery, and some troubleshooting.

Deliverable 4.3. The contractor shall edit or develop SOPs for each device which shall be approved by the WACOR and EPA before field collocation or shipment to the local operators.

Deliverable 4.4. The contractor shall conduct filter room evaluation (~3 days) and field collocation evaluation of the sensors at AIRS (~2 weeks) to collect intercomparison data.

Deliverable 4.5. The contractor shall conduct video and in-person training sessions in RTP with local operators to demonstrate the setup, operation, and data download of each of the sensors prior to shipping sensors to the remote local operators no later than May 31, 2019.

Deliverable 4.6. The contractor shall securely box the sensors and arrange for the shipment to the local technicians and shall maintain a chain of custody records. Sensors shall be shipped, installed, and collecting data no later than June 28, 2019.

Deliverable 4.7. Should any sensor fail to function during a deployment, the contractor shall assist with troubleshooting efforts and, if necessary, arrange for the malfunctioning pod to be returned for inspection and repair.

Deliverable 4.8. The contractor shall coordinate receipt of data from the local technicians, the state/local agency technical point of contact (site owner), or cloud (for select sensors) including sensor and reference data according to the QAPP and shall monitor the transmission schedule and follow-up as necessary. The contractor shall make the data available to the WACOR within 24-hours of receipt.

Task 5 Sensor Evaluation

Deliverable 5.1. The contractor shall acquire all sensors specified by technical direction as soon as possible with delivery no later than January 15, 2020.

Deliverable 5.2. The contractor shall develop a WACOR approved SOP for each device a minimum of 30 days prior to the planned collocation deployment.

Deliverable 5.3. The contractor shall conduct field evaluation of sensors in small batches via collocation with reference monitors for a minimum of 30 days. Evaluation of the final batch shall begin no later than January 15, 2020.

Deliverable 5.4. The contractor shall recover data from the sensors on at least a weekly basis and shall provide the data to the WACOR within 24 hours.

Task 6 Air Sensor Lab Design

Deliverable 6.1. The contractor shall develop a schematic and talk the WACOR through how the various components address EPA needs at least monthly. All design work shall be documented in the electronic notebook. A final rendering of the design is due to EPA concurrent with the final list of components (Deliverable 6.2).

Deliverable 6.2. The contractor shall develop a list of all components in the final design schematic. Draft list was submitted during Option 3 and shall be updated no later than 2 weeks after receipt of EPA comments and the requested building facilities information. A final list shall be due 30 days after receiving EPA comments on the updated draft.

Deliverable 6.3. A final design document shall incorporate together all components of this work (e.g., schematic, component list, sole source justifications, design documents, research questions and answers, proposed lab modifications, fabrication information) in a single technical report. This final document shall be delivered no later than 30 days after delivery Deliverables 6.1 and 6.2. Any necessary revisions following WACOR review shall be delivered within two weeks.

EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 4-125

☐ Other ☒ Amendment Number: 000001

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-15-008	Base X To Option Period Number	

Contractor: JACOBS TECHNOLOGY INC.

Specify Section and paragraph of Contract SOW:

Purpose:
- ☐ Work Assignment
- ☒ Work Assignment Amendment
- ☐ Work Plan Approval
- ☐ Work Assignment Close-Out
- ☐ Incremental Funding

Period of Performance: From 04/01/2019 To 03/31/2020

Comments:

☐ Superfund — Accounting and Appropriations Data — ☒ Non-Superfund

SFO (*Max 2*): ☐

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code
1										
2										
3										
4										
5										

Authorized Work Assignment Ceiling

Contract Period:	Cost/Fee:	LOE:
To		
This Action:		
Total:		

Work Plan / Cost Estimate Approvals

Contractor WP Dated:	Cost/Fee	LOE:
Cumulative Approved:	Cost/Fee	LOE:

Work Assignment Manager Name: Andrea Clements (Signature) (Date)	Branch/Mail Code: Phone Number: 919-541-1363 FAX Number:
Project Officer Name: Robin S. Harris (Signature) (Date)	Branch/Mail Code: Phone Number: 919-541-0955 FAX Number:
Other Agency Official Name: (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:
Contracting Official Name: Keith Pfeffer (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:

Performance Work Statement

Amendment 000001

Note: This PWS Amendment (000001) only updates the below WACOR and Alternate WACOR information.

WA Title: Sensor Loan Program and Sensor Evaluation Technical Support

WA #: 4-125

WACOR: ~~Vasu Kilaru~~ Andrea Clements

Contract #: EP-C-15-008

Alternate WACOR: ~~TBD~~ Vasu Kilaru

PERIOD OF PERFORMANCE

The period of performance detailed in this PWS shall be from April 1, 2019 through March 31, 2020.

SUMMARY OF OBJECTIVES

This work assignment shall provide follow-on field and laboratory technical support for **four** main projects.

1 - The first project, entitled "Sensor Pod Loan Trial for Investigating Regional and Community Air Pollution", is a collaboration between the Environmental Protection Agency's Office of Research and Development (EPA/ORD) and multiple EPA Regions. Herein, this project shall be referred to as the "Sensor Loan Program".

The overall goal of the sensor loan program from EPA/ORD's perspective is to evaluate the practical and technical aspects of a sensor pod loan program. Specific objectives: 1) better understand regional needs and prospective applications of low-cost sensor technologies; 2) estimate the costs (both direct and indirect) associated with developing a larger scale sensor loan program; 3) determine the robustness of sensor pods and calibrations through repeated deployments in meteorologically contrasting locations and seasons; 4) gauge the effectiveness of training and guidance documents in helping to guide regional partners; 5) evaluate the extent to which regions can independently conduct field campaigns to answer regionally relevant questions. Results of these evaluations shall be used to guide improvements to guidance materials.

2 - The second project is a continuation of emerging low-cost air quality sensor evaluations previous conducted under WA 1-115, 2-125, and 3-125. Herein, this project shall be referred to as "Sensor Evaluation".

The overall goal of the sensor evaluation work is to assess the performance of a variety of new air quality sensors compared to reference grade (FRM, FEM, or other as defined by the WACOR) measurements. Specific objectives: 1) identify popular or promising new devices for measurement of one or more NAAQS pollutants; 2) conduct an initial performance evaluation to determine the robustness and usefulness of the device through collocation of triplicate sensors at the AIRS platform; 3) report the evaluation findings to inform other users or potential users of

the evaluated device; 4) if warranted, conduct further performance evaluation of the device in laboratory or field environments.

3 - The third project, entitled "Long-Term Ambient Air Quality Sensor Performance Evaluation", is an investigation of the long-term performance of air quality sensors under various conditions in six different locations within the continental US. Herein, this project shall be referred to as the "Long-Term Performance Project".

The overall goal of the long-term performance project is to evaluate the change in performance of sensors under a variety of ambient conditions as they age. Specific objectives: 1) identify three of the most popular sensor technologies in use today; 2) identify approximately 6 regulatory monitoring sites in distinctly different environments within the continental US that are running the same types of FRM/FEM instruments and are measuring all of the same pollutants as the chosen sensors; 3) deploy the same set of sensor types at each of the regulatory monitoring sites where local personnel operate them for a period of 9 months to not more than 1 year collecting data weekly; 4) compare the sensor data to the collocated reference data to monitor for degradation in the agreement between the measurements and to determine the rate of degradation; 5) determine how the rate of degradation in the agreement is influenced by the local environmental conditions (meteorology or pollutant concentrations).

4 - The fourth project, entitled "Air Sensors Lab Design", is the development of a design document for the air sensors laboratory. Herein, this project shall be referred to as the "Lab Design".

The overall goal of the lab design project is to develop a laboratory design document containing 1) vendors, part numbers, price quotes, and specifications for the commercial equipment and components complete with specifics including tubing and fittings, 2) design and fabrication documents for components that should be built or changes that should be made to the lab infrastructure, 3) and renderings of the final integrated design needed to build out the air sensors lab. The design document shall prioritize function but shall also consider the most cost-effective ways of meeting evaluation needs.

BACKGROUND

Recent advances in air pollution monitoring technology have led to the development of sensors that are much smaller and lower in cost than traditional ambient air monitoring systems. One of the potential benefits of smaller, less expensive sensors is the ability to deploy a larger number of them across a small geographic area (e.g. a neighborhood) to collect data with a level of spatial and temporal resolution that is neither available nor feasible using traditional regulatory quality monitoring methods.

Additionally, the small size and cost allow multiple sensors to be combined into a single device (pod), providing the ability to monitor multiple pollutants simultaneously with a single device. The sensor loan program will use such a device to give EPA Regions access to cutting edge sensor technology to investigate local and regional air quality while relieving them of the technical burdens and maintenance aspects of having to develop a similar capability.

Manufacturers are continuing to develop user-friendly and field deployable devices to measure a single pollutant or multiple pollutants. These devices are useful for EPA and other researchers to achieve research goals that include community-level air monitoring. Additionally, these devices are attractive tools for communities to conduct their own air monitoring. Thus, EPA needs more information about their performance to properly interpret and respond to the data being produced by these devices. The sensor evaluation work will focus on products with high potential for use by communities, citizen groups, and others.

EPA's sensor evaluation work has traditionally relied on field collocation near reference-grade instruments to evaluation sensor performance. This technique will be relied upon heavily during this WA but, plans are needed to outfit the air sensors laboratory (D 566A-EPA/RTP campus) with the capability to conduct sensor evaluations under controlled conditions. Adding this capability will allow EPA to test sensors under conditions that are not readily available in the RTP area including ultra-low and high conditions, a wider range of relative humidity and temperature conditions, etc. in the future.

SCOPE

The sensor loan programs shall be conducted under multiple tasks that accomplish the following:

1. Complete purchase of 20 multi-pollutant sensor pods from Aerodyne Research.
2. Prepare sensor pods for field deployment and evaluation.
3. Evaluate the sensor pods via collocation with reference monitors at the Air Innovation Research Site (AIRS) on the EPA RTP campus.
4. Track and ship sensor equipment being loaned to regional partners.
5. Inspect, repair, and evaluate via short collocation at AIRS between loans.

The sensor evaluations shall be conducted under several tasks that accomplish the following:

1. Purchase, prepare, and deploy up to 10 additional air quality sensors or multi-pollutant sensor pods for collocation evaluation at the AIRS platform.
2. Finish preparation of a written report documenting the details of the collocation evaluations conducted during the last option period and any new evaluations conduced during this option period.

The long-term performance project shall be conducted under multiple tasks that accomplish the following:

1. Finish procurement of sensors and preparation of operational SOPs.
2. Secure local operators for the field locations who will deploy, support, and download data from each of the sensors.
3. Conduct training for local operators and other partners.
4. Package, track, and ship sensors to local operators.
5. Receive, compile, and review data from the sensors and collocated reference monitors.
6. Prepare a written report documenting the details of this project including preparation activities, observations, lesson learned, recommendations, etc.

The lab design project shall require the Contractor to accomplish the following:

1. Finish development of a rendering of the design needed to build out the air sensors lab.

TECHNICAL APROACH/OBJECTIVES

The technical approach is divided into tasks. These tasks combined achieve the overall project objectives of supporting the sensor loan program and facilitating sensor evaluation.

For the sensor loan program, the WACOR will provide technical direction on the evaluation period and methods used before and between deployments and shipping address and length of loans for each regional deployment. For the sensor loan program and the long-term performance project, the contractor shall be responsible for tracking the sensors and components (ORD property). The contractor shall document all costs, observations made while carrying out each task, changes from documented procedure, and problems and their solutions. The contractor shall maintain all chain or custody and data records and supply those to the WACOR at the end of this work assignment.

For the sensor evaluation work, the WACOR will provide technical direction on the types and number of sensors purchased, the evaluation period and methods used. If needed, the contractor shall be responsible for properly handling this ORD property and shall ensure the WACOR always knows the location of property. This property shall be returned to the WACOR at the end of this work assignment. The contractor shall document all costs, observations made while preparing the sensors, deploying them to the AIRS platform, and in evaluating and analyzing the data. The contractor shall document all changes from documented procedures, and problems, troubleshooting efforts, and solutions. The contractor shall maintain laboratory and field notebooks that will be shared with and supplied to the WACOR at the end of this work assignment.

Task #1. Communication and Documentation

To assist the contractor in understanding the PWS for development of their cost estimate, a kick-off meeting shall be held within one week of the WA initiation date. This kick-off meeting shall be attended by key contractor personnel anticipated to be involved in work and the EPA WACOR.

Following the kick-off meeting, the contractor shall participate in bi-weekly meetings established by the WACOR to provide updates on project tasks and to discuss any technical or other issues that have arisen.

In support of research objective #2 of the sensor loan program, the contractor shall develop a monthly report which details a brief status update, direct cost expenditures, and hours expended per person for each task.

The contractor shall keep research notebook(s) (paper, electronic, or both) documenting details of all work done for each task. The contractor shall take all available laboratory notebook

training (contact NERL/EMMD/SSAB QA Manager Christine Alvarez) and shall comply with all EPA-specific laboratory notebook protocols. The contractor shall share electronic notebooks with the WACOR throughout the project according to procedures provided in technical direction. A paper research notebook may also be maintained and would be especially useful for field activities at AIRS. The contractor shall deliver all paper notebooks and all chain of custody and shipment documentation to the WACOR at the conclusion of this work assignment.

The contractor shall provide data, as well as associated field notes, observations, and troubleshooting efforts, to the WACOR within 24 hours of data download and/or transmittal. All data download activities shall be maintained within the research notebook.

The contractor shall develop an EPA report documenting the details of the work done in support of the sensor evaluation efforts (Task 5) and a separate report detailing the support, sensor siting, and operation of the sensors deployed for the LTPP (Task 4). The WACOR will provide an example document and template to guide the development of the report. Personnel with technical writing experience shall best be able to achieve the level of detail and writing quality needed to develop this report. Draft reports for the sensor evaluation work (Task 5 plus collocation results for loaned sensors used in the Regional Sensor Loan Project) are due September 30, 2019 and January 31, 2020. A final report is due March 31, 2020. Draft reports for the long-term sensor performance work (Task 4) are due July 31, 2019 and December 2, 2019 with a final report due March 31, 2020.

Task #2. ARISense Pod Purchase and Preparation

The contractor shall complete the purchase of 26 ARISense multi-pollutant sensor pods from Aerodyne Research initial ordered during Option Period 3. 20 pods shall support the Regional Sensor Loan Program and 6 shall support the Long-Term Performance Project. All sensor pods shall be capable of running on AC power with seven (7) equipped to also run on solar power with battery backup. The contractor shall work with EPA to enter the devices into the property control database and tag the equipment. The contractor shall label all sensor pod components, according to technical direction, to keep the components for each sensor pod together.

The contractor shall develop a Standard Operating Procedure (SOP) that is suitable for use by Regions and their community. EPA shall review the document and the contractor shall edit these procedures to address all comments and concerns provided by the WACOR and shall be approved by EPA before beginning collocation evaluation.

Following SOP approval, the contractor shall conduct field collocation evaluations of the pods via collocation with reference monitors at AIRS. Simultaneous collocation is preferred. If necessary, the contractor shall collocate the pods in two batches, one containing 20 sensor pods and the other containing 6. The contractor shall perform sensor collocation evaluation according to the existing Quality Assurance Project Plan (QAPP) #D-EMMD-0031530-QP-1-0. EPA will provide space, power, and access to the AIRS platform. The length of this collocation evaluation will be specified by technical direction in consideration of the loan schedule but shall last at least 4 weeks. **This initial collocation effort shall also be considered an evaluation and details shall be included in the evaluation report (Task 5).** The contractor shall ready the AIRS site with any

necessary supporting equipment in advance of field deployment (power cords, mounting poles, etc.). Following formal evaluation, the contractor shall update the SOP if needed and according to technical direction.

Task #3. Sensor Loan Project Support

The WACOR will provide the contractor with all details necessary for loaning the pods to the participating EPA Regions (i.e., which pods and power requirements, how many, where, when, for how long). The contractor shall securely box the sensors and all peripheral components to minimize the possibility of damage in transit using pelican style hard cases with customizable form inserts, the design of which shall be approved by the WACOR. The contractor shall purchase peripheral equipment to support the devices including USB power port hubs to charge batteries (7x4 = 28 USB ports available). The contractor shall arrange for the shipment or delivery of pods with tracking to and from Regional partners in the most cost-effective manner possible according to the schedule specified by the WACOR in technical direction. Expedited shipping shall require justification and WACOR approval. A method for tracking the location of each sensor pod and for maintaining a chain of custody shall be proposed and approved by the WACOR and strictly adhered to by the contractor.

Should any pods fail to function during a deployment, the contractor shall remotely assist with non-evasive troubleshooting efforts and/or arrange for the malfunctioning pod to be returned for inspection and repair. **Observations and efforts shall be included in the evaluation report (Task 5).**

After each Regional deployment, the contractor shall coordinate return of the loaned sensor equipment, including scheduling pickup and shipping of the sensors. Within three (3) calendar days of return, the contractor shall inspect the returned shipment, inventory all components, and inspect for damage. The contractor shall immediately notify the WACOR about missing components or damage. If needed and specified by technical direction, the contractor shall arrange for repair of any damaged equipment through the commercial vendor, though possibly some repairs could be performed in-house after consulting with the vendor.

Within 1 week of return, from the region or from repair (if needed), the contractor shall perform a collocation evaluation of the sensors at AIRS to confirm acceptable performance before the equipment is loaned out for another deployment. The length of this collocation evaluation shall be specified by technical direction in consideration of the loan schedule but shall last at least 2 weeks. **These short collocation effort observations shall also be included in the evaluation report (Task 5).**

Task #4. Long-Term Performance Project Support

The contractor shall complete preparation of 6-9 copies of 6 sensor types (Purple Air, APT Maxima, Sens-it RAMP, Aerodyne Research ARISense, Aeroqual AQY, and Clarity Node). This shall involve finishing acquisition (if outstanding from WA 3-125), acceptance of loaned equipment (CRADA, MTA, or EPA acquisition), and benchtop operational testing. If necessary, the contractor shall work with EPA to enter the devices into the property control database and tag

the equipment. Sensors that consist of multiple components shall be further labeled, according to technical direction, to keep the components for each sensor system together.

The contractor shall immediately identify local technicians to support 4 of the 6 identified field sites (DE, GA, OK, CO). The local technician shall be technically knowledgeable of air quality and instrumentation. Each local technician shall be responsible for attending training, receiving the sensors, deploying them at the field site near federal reference monitors in coordination with the site contact, for manually recovering the data at least weekly (as needed), for emailing those files to the WACOR and contractor staff, and for monitoring the routine operation of the sensors. The local technician shall maintain sensor operation and time check notes using log sheets designed and provided by the contractor. Should any sensor fail to function during a deployment, the contractor shall assist with troubleshooting efforts and, if necessary, arrange for the malfunctioning sensor to be returned for inspection and repair.

The state/local agency technical point (site owner), local technician, or contractor shall also be responsible for recovering the nearby reference and meteorological data at the highest time resolution available (1-minute preferred) at least monthly; the person responsible shall be determined independently by site and detailed in the Long-Term Performance Project QAPP. The contractor shall be responsible for following up with the local staff should data not arrive on the agreed upon schedule, reviewing the data as it comes in to monitor for sensor malfunction, and compiling the data (sensor and reference) into a shared project folder for access by both contractor and EPA staff. The contractor shall maintain notes pertaining to observations (regarding sensor operation and/or data). The data files shall be maintained in a shared file location (O: drive) for regular access.

Following preparation, the contractor shall deploy the sensors for a short period in the filter weight room and for a collocation period at AIRS to verify operational status and to check for abnormal performance. The length of these evaluations shall be specified by technical direction but shall last at least 3 days in the filter room and at least 2 weeks (longer better) at AIRS. This data also provides a comparison for how the sensors compared prior to remote deployment. The contractor shall verify operational status of the sensors daily to identify and resolve any problems as quickly as possible. If necessary, the contractor shall consult with the manufacturer to permanently resolve any issues. The contractor shall keep field notes in the assigned research notebook. EPA will provide space, power, and access to the AIRS platform for this test. The contractor shall ready the AIRS site with any necessary supporting equipment in advance of field deployment (power cords, mounting poles, etc.). The chicken coop structure already in position at the AIRS site shall be available to support the field deployment, if needed. The contractor shall deploy all copies of a sensor device at the same time. The contractor shall recover data from the sensors on at least a weekly basis and shall provide the data to the WACOR within 24 hours of download.

The short collocation period provides an ideal opportunity for training remote local operators. The contractor shall video record a demonstration of the setup, operation, and data download of each of the sensors. The local technical staff identified by the contractor shall be brought to the RTP campus for training on field operations including the setup, routine operation, data

download, and data transmission as well as any potential troubleshooting they may be asked to do. For cost estimation purposes, the contractor shall assume one field operator will be trained for each field site. The contractor shall be available for remote audio and visual support as local operators install the sensor equipment at the field sites and during troubleshooting.

Once the WACOR is satisfied with all aspects of the sensor operations (operation, preparation, etc.), the WACOR will issue technical direction for 6 of each sensor type to be securely packaged and shipped to the field sites (if available, the remaining 3 will remain deployed at AIRS). The contractor shall maintain shipping and chain of custody records which shall be delivered to the WACOR before the end of the performance period. Before deployment, the contractor shall review the long-term performance project QAPP (#D-EMMD-0031862-QP-1-0) and the sensor SOPs to ensure they provide the correct project details and instructions necessary to support remote operation by the local operators. The contractor shall request amendment (seeking EPA approval) if needed.

The contractor shall provide a separate report for the long-term performance project which details the sensor preparation, siting, operation, and observations to the WACOR. Technical direction and the same example document and template provided for the sensor evaluation effort can serve as a guide the development of the report. Personnel with technical writing experience shall best be able to achieve the level of detail and writing quality needed to develop this report. Draft reports for the long-term sensor performance work are due July 31, 2019 and December 2, 2019 with a final report due March 31, 2020.

Task #5. Sensor Evaluation

The contractor shall support the collocation evaluation of a maximum of 10 sensor types, in triplicate as specified by technical direction. The sensors shall be commercial sensors or OEM sensors with data acquisition support (no expensive assembly required) and may be single pollutant or multi-pollutant sensor pods. For work plan cost estimation purposes, the contractor shall assume a retail cost of no more than $5,000 for all equipment purchased for evaluation.

The sensors shall be selected through Contractor-WACOR discussion and ultimately technical direction. This shall include evaluation of the APIS multi-pollutant sensor started under WA 3-125. Other examples include, but are not limited to, AQTreks PAM, PocketLab Air, Senserion PM sensor, uRAD city model, Air Quality Egg (newly updated), Kunak, Praxis, Libilium, SailHero, Lunar Outpost Canary, and Blue Tomorrow. Should sensors not on this list (e.g., AirVisual) be identified for evaluation, the WACOR will be responsible for amending the project QAPP. Equipment purchase shall begin as soon as possible after technical direction. If necessary, the contractor shall work with EPA to enter the devices into the property control database and tag the equipment. Sensors that consist of multiple components shall be further labeled, according to technical direction, to keep the components for each sensor system together.

Once a sensor is ready for field evaluation, the contractor either shall develop a SOP, using the EPA approved template, detailing the operation and data download procedures for the sensors or present a complete user manual that may be approved by EPA in lieu of the SOP. The contractor

shall address all feedback from EPA and the SOP or manual shall be approved by EPA before beginning the formal evaluation period.

Following purchase, preparation, and document approval, the contractor shall conduct field evaluation of sensors via collocation with reference monitors. EPA will provide space, power, and access to the AIRS platform. The contractor shall ready the AIRS site with any necessary supporting equipment in advance of field deployment (power cords, mounting poles, etc.). The chicken coop structure already in position at the AIRS site shall be available to support the field deployment, if needed. The contractor shall deploy three copies of each sensor device at the same time. Subject to WACOR approval, the contractor may conduct the evaluation of the sensor devices in small batches. Evaluation of the final batch shall begin no later than January 15, 2020.

The contractor shall verify the operational status of the sensors daily to identify and resolve any problems as quickly as possible. The contractor shall keep field notes in the assigned research notebook. The contractor shall recover data from the sensors on at least a weekly basis and shall provide the data to the WACOR within 24 hours of download.

After an initial evaluation period and once the WACOR is satisfied with all aspect of the sensor operations, including data recovery and data quality, the WACOR will issue technical direction for a formal evaluation period of at least 30 days, up to 90 days. During this time, the contractor shall maintain the weekly data recovery frequency and 24-hour turn-around. Following evaluation, the contractor shall update the SOP and data processing solution as needed and according to technical direction.

The contractor shall provide details of the evaluation work (general information, preparation work, evaluation observations, troubleshooting/resolution details to issues encountered, and data observations and definitions (as necessary)) in an EPA report by the end of this WA. Report drafts due September 30, 2019 and January 31, 2020. A final report is due March 31, 2020.

Task #6. Air Sensors Lab Design

The Air Sensors lab (D566A) is an existing EPA laboratory space that has recently been re-assigned to be a hub for air sensor related work. EPA wishes to eventually outfit this space to include the capacity to conduct sensor evaluations, in triplicate, under controlled conditions including variable particle types and concentrations, gas types and concentrations, relative humidity, and temperature. The design shall include gas and particle generating, mixing, and delivery systems, an exposure chamber, a manifold system, reference analyzers, and exhaust plans. This design work shall address all aspects of the design to make these needs possible from specs for commercial components all the way down to a plan with the tubing and fittings needed to fully assemble such a system. This design shall also consider routine cleaning, maintenance and operation and thus shall design for easy monitoring and access to consumables and changeable features like valves and connections.

Under WA 3-125, the contractor created a scoping document, a draft drawing for the chamber design, a preliminary component list, and a list of questions to be answered by EPA facilities.

The contractor shall finish this work by developing a final component list for the final design schematic. This list shall include the component name, vendor, part number, price quote, and any detailed specifications needed to purchase the equipment (including sole source justification, if applicable). This list shall not only include the large commercial components (e.g., CAPS NO_2 analyzer) but the small components (e.g., tubing and fittings) that make up the entire system. The schematic shall also show how the components should be oriented and connected to make up the fully assembled system. Technical direction may be used to prioritize the component list based on EPA funding mechanisms. A second draft list shall be due 2 weeks after receipt of EPA comments and building facilities information. A final list shall be due 30 days after receiving EPA comments from draft #2.

The contractor shall consider and develop a document detailing questions and suggested changes for the lab infrastructure (e.g., reconfiguration of lab benches, new outlets, duct work) so that such changes can be discussed and ultimately requested from building facilities. If requested, the WACOR can facilitate a meeting between the contractor and facilities staff to discuss the necessary details. This work can be submitted on an ongoing basis and shall be addressed as soon as questions or suggestions arise to avoid assumptions that turn out to be false thus wasting time and effort.

The laboratory design shall prioritize function over cost, but, cost shall still be considered. If it makes sense for a component (e.g., a chamber, a manifold system) to be built in-house or re-purposed from another experiment, the contractor shall develop design documents so that technical staff can build or adapt the equipment needed. These designs shall be complete and specific allowing a technical staff person to quickly and easily quote and accomplish the job using appropriate materials.

All of the above-mentioned design documents (schematic, component list, sole source justifications, design documents) shall be compiled into a single technical report for easy reference. These design document in its entirety shall be delivered no later than 30 days after delivery of the final component list. Any necessary revisions following WACOR review shall be delivered within two weeks.

QUALITY ASSURANCE (QA)

The WACOR has revised the Air Sensor Evaluation QAPP so that the QA guidelines specified are all clearly defined within one document for easier reference. This QAPP is #D-EMMD-0031530-QP-1-0 titled, "Field Collocation of Air Quality Sensors with Reference Grade Instruments." This document shall govern all sensor evaluation efforts and the collocation of sensors pods used in the loan program while collocated at AIRS before and between loan periods.

Under WA 3-125, the contractor developed the "Air Quality Sensors - Long-Term Performance Project" QAPP (#D-EMMD-0031862-QP-1-0). This document is expected to be finalized early in WA 4-125 (prior to shipment of equipment to field locations) and shall govern the long-term performance project efforts.

EPA/ORD, in collaboration with the contractor, will modify these QAPPs on an as needed basis if additional quality requirements or changes are necessary.

DELIVERABLES and their Schedule

Task 1 Communication and Documentation

Deliverable 1.1. The contractor shall attend a kick-off meeting within two weeks of the WA effective date (4/1/2019).

Deliverable 1.2. The contractor shall participate in bi-weekly meetings established by the WACOR to provide updates on project tasks and to discuss any technical or other issues that have arisen.

Deliverable 1.3. The contractor shall keep research notebook(s) according to EPA protocols describing all work done for each task. Electronic notebooks shall be shared with the WACOR throughout the project. Paper notebooks shall be delivered to the WACOR no later than March 31, 2020.

Deliverable 1.4. The contractor shall provide all chain of custody and shipment documentation by March 31, 2020.

Deliverable 1.5. In support of research objective #2 of the sensor loan program, the contractor shall develop a monthly report, due the 15th of the following month, which details a brief status update, direct cost expenditures, and hours expended per person for each task.

Deliverable 1.6. The contractor shall provide data to the WACOR within 24 hours of data download and/or transmittal.

Deliverable 1.7. The contractor shall develop an EPA report documenting all the details and outcomes of the evaluation conducted under Task 5 plus the collocation results for sensors loaned for the Regional Sensor Loan Project. Report drafts due September 30, 2019 and January 31, 2020. A final report is due March 31, 2020.

Deliverable 1.8. The contractor shall develop an EPA report documenting the details of the long-term performance project (Task 4). Draft reports for the long-term sensor performance work are due July 31, 2019 and December 2, 2019 with a final report due March 31, 2020.

Task 2 Pod Purchase

Deliverable 2.1. The contractor shall complete the purchase 26 multi-pollutant sensor pods from Aerodyne Research initially ordered during Option Period 3. Delivery expected in early April but no later than April 30, 2019.

Deliverable 2.2. The contractor shall work with EPA to enter the devices into the property control database and tag the equipment within 30 days of receipt.

Deliverable 2.3. The contractor shall develop a SOP suitable to use by non-experts within 30 days of receipt.

Deliverable 2.4. The contractor shall conduct filter room tests and field evaluations of the pods via collocation with reference monitors lasting a minimum of 30 days and finishing within 50 days of the SOP approval.

Task 3 Sensor Loan Project Support

Deliverable 3.1. The contractor shall securely box the sensors in pelican style cases and arrange for the shipment of pods to and from Regional partners and shall maintain a chain of custody records.

Deliverable 3.2. The contractor shall purchase peripheral equipment to support the devices including USB power port hubs to charge batteries records.

Deliverable 3.3. Should any pod fail to function during a deployment, the contractor shall conduct remote troubleshooting and/or arrange for the malfunctioning pod to be returned for inspection and repair.

Deliverable 3.4. Within three (3) calendar days of return, the contractor shall inspect the returned pods, account for all components, inspect for damage, and arrange for any necessary repair.

Deliverable 3.5. Within 1 week of return, from the region or from repair (if needed), the contractor shall perform a collocation evaluation of the sensors at the AIRS station to confirm acceptable performance before the equipment is loaned out for another deployment.

Task 4 Long-Term Performance Project Support

Deliverable 4.1. The contractor shall complete preparation of 6-9 copies of 6 sensor types (Purple Air, APT Maxima, Sens-it RAMP, Aerodyne Research ARISense, Aeroqual AQY, and Clarity Node). When appropriate the contractor shall work with EPA to enter the devices into the property control database and tag the equipment.

Deliverable 4.2. The contractor shall immediately identify local technicians to support 4 of the 6 identified field sites (DE, GA, OK, CO). The local technician shall be responsible for deployment, site visits, data recovery, and some troubleshooting.

Deliverable 4.3. The contractor shall edit or develop SOPs for each device which shall be approved by the WACOR and EPA before field collocation or shipment to the local operators.

Deliverable 4.4. The contractor shall conduct filter room evaluation (~3 days) and field collocation evaluation of the sensors at AIRS (~2 weeks) to collect intercomparison data.

Deliverable 4.5. The contractor shall conduct video and in-person training sessions in RTP with local operators to demonstrate the setup, operation, and data download of each of the sensors prior to shipping sensors to the remote local operators no later than May 31, 2019.

Deliverable 4.6. The contractor shall securely box the sensors and arrange for the shipment to the local technicians and shall maintain a chain of custody records. Sensors shall be shipped, installed, and collecting data no later than June 28, 2019.

Deliverable 4.7. Should any sensor fail to function during a deployment, the contractor shall assist with troubleshooting efforts and, if necessary, arrange for the malfunctioning pod to be returned for inspection and repair.

Deliverable 4.8. The contractor shall coordinate receipt of data from the local technicians, the state/local agency technical point of contact (site owner), or cloud (for select sensors) including sensor and reference data according to the QAPP and shall monitor the transmission schedule and follow-up as necessary. The contractor shall make the data available to the WACOR within 24-hours of receipt.

Task 5 Sensor Evaluation

Deliverable 5.1. The contractor shall acquire all sensors specified by technical direction as soon as possible with delivery no later than January 15, 2020.

Deliverable 5.2. The contractor shall develop a WACOR approved SOP for each device a minimum of 30 days prior to the planned collocation deployment.

Deliverable 5.3. The contractor shall conduct field evaluation of sensors in small batches via collocation with reference monitors for a minimum of 30 days. Evaluation of the final batch shall begin no later than January 15, 2020.

Deliverable 5.4. The contractor shall recover data from the sensors on at least a weekly basis and shall provide the data to the WACOR within 24 hours.

Task 6 Air Sensor Lab Design

Deliverable 6.1. The contractor shall develop a schematic and talk the WACOR through how the various components address EPA needs at least monthly. All design work shall be documented in the electronic notebook. A final rendering of the design is due to EPA concurrent with the final list of components (Deliverable 6.2).

Deliverable 6.2. The contractor shall develop a list of all components in the final design schematic. Draft list was submitted during Option 3 and shall be updated no later than 2 weeks after receipt of EPA comments and the requested building facilities information. A final list shall be due 30 days after receiving EPA comments on the updated draft.

Deliverable 6.3. A final design document shall incorporate together all components of this work (e.g., schematic, component list, sole source justifications, design documents, research questions and answers, proposed lab modifications, fabrication information) in a single technical report. This final document shall be delivered no later than 30 days after delivery Deliverables 6.1 and 6.2. Any necessary revisions following WACOR review shall be delivered within two weeks.

EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 4-126

☐ Other ☐ Amendment Number:

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-15-008	04/01/2015 To 03/31/2020 Base Option Period Number 4	See attached PWS

Contractor: JACOBS TECHNOLOGY INC.

Specify Section and paragraph of Contract SOW: Section 2.0

Purpose:
- [X] Work Assignment
- [ ] Work Assignment Amendment
- [ ] Work Plan Approval
- [ ] Work Assignment Close-Out
- [ ] Incremental Funding

Period of Performance: From 04/01/2019 To 03/31/2020

Comments:

Work Plan due 4/29/19.

No work, including but not limited to preparation of the Work Plan, shall begin until 4/1/19.

☐ Superfund — Accounting and Appropriations Data — [X] Non-Superfund

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

SFO (*Max 2*) ☐

Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code
1										
2										
3										
4										
5										

Authorized Work Assignment Ceiling

	Cost/Fee	LOE
Contract Period: 04/01/2015 To 03/31/2020		
This Action:		
Total:		

Work Plan / Cost Estimate Approvals

	Cost/Fee	LOE
Contractor WP Dated:		
Cumulative Approved:		

Work Assignment Manager Name: Chandra Giri (Signature) (Date)	Branch/Mail Code: Phone Number: 919-541-4639 FAX Number:
Project Officer Name: Robin S. Harris (Signature) (Date)	Branch/Mail Code: Phone Number: 919-541-0955 FAX Number:
Other Agency Official Name: (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:
Contracting Official Name: Keith Pfeffer (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:

Performance Work Statement

WA Title: Mangrove Monitoring

WA #: 4-126 WACOR: Chandra Giri

Contract #: EP-C-15-008 Alternate WACOR: TBD

This WA is a continuation of a previous WA (3-126).

PERIOD OF PERFORMANCE

The period of performance detailed in this Performance Work Statement (PWS) shall be from April 1, 2019 through March 31, 2020.

SUMMARY OF OBJECTIVES

Scientific understanding of the rates, patterns, and causes of changes in mangrove cover, and the impacts of such changes on ecosystem services, is limited. To help fill this gap, we propose to examine the dynamics of mangrove forests from 1985 to present—this will help assess the consequences for two globally important ecosystem services, carbon sequestration and biodiversity conservation. To do this, we will integrate research in remote sensing, conservation biology, and environmental economics. Specific objectives of the project are:

Objective 1: develop an operational methodology for detecting and monitoring mangrove cover dynamics on an annual basis;

Objective 2: create a comprehensive database of mangrove cover change on an annual basis from 1985 to the present at 30 m resolution;

Objective 3: quantify carbon stock change on an annual basis

BACKGROUND

Remaining global mangrove areas comprise 137,760 square kilometers, spanning in 118 countries and territories in the tropical and subtropical regions of the world. They are among the world's most threatened and rapidly declining ecosystems.

However, our scientific understanding of the rates, patterns, causes, and consequences of mangrove change is limited. With the availability of remote sensing technology, it is now possible to map and monitor mangroves on an annual basis.

Mangroves are highly productive ecosystems that store more carbon than any other tropical ecosystem per unit of area. They have a mean whole-ecosystem carbon stock (i.e., above-ground plus below-ground) of 956 t C ha^{-1}, compared to 142 t C ha^{-1} for seagrasses, 241 t C ha^{-1} for tropical rain forests, 408 t C ha^{-1} for peat swamps, and 593 t C ha^{-1} for salt marshes. Soil carbon constitutes approximately 75% of the mangrove carbon pool. Although mangroves occupy less than 1% of global coastal area, they contribute 10–15% (24 Tg C y^{-1}) to coastal sediment carbon storage and export 10–11% of total particulate terrestrial carbon to the ocean.

Mangroves' disproportionate contribution to carbon storage is now perceived as a means and justification for enhanced conservation and restoration and a way to help mitigate greenhouse

gas emissions. The best available estimates indicate that 0.15–1.02 Pg (billion) tons of carbon dioxide are being released from mangroves annually due to deforestation and forest degradation, causing economic damages of US $6–42 billion annually. The magnitudes of carbon stocks, carbon stock variability, and changes in carbon stocks in mangroves are still active and contested areas of research, however, with uncertainty in the estimation of deforestation, degradation, and carbon stock changes in mangroves remaining very high. Reliable annual estimates of deforestation, forest degradation, and associated carbon stock changes are needed at a national scale to support inclusion of mangroves in the United Nations Collaborative Program on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (REDD+), as well as to advance NASA's Carbon Monitoring System research. Development of a prototype Monitoring Reporting and Verification (MRV) system for mangroves in developing countries is urgently needed to generate transparent estimates that achieve the levels of accuracy and precision required by current UNFCCC guidance. In the absence of such information, the blue carbon market will be slow to emerge, as investors in carbon sequestration projects demand a high level of certainty about project quality.

SCOPE

The contractor shall initially work on the study region including coastal mangrove areas in South Asia, Puerto Rico, USA, New Zealand, Africa, and other areas of the world.

Specific responsibilities shall include:

- Download and acquire satellite data from multiple sources
- Development of 30 meters' mangrove data from Landsat satellite data using software such as ERDAS Imagine or Google Earth Engine
- GIS (Geographic Information System) processing of data layers
- Quality control of geospatial data
- Creation of metadata and fact sheets supporting the data products
- Assist in field data collection

TECHNICAL APROACH/OBJECTIVES

The contractor shall map and monitor mangroves on an annual basis from 1985 to the present. This shall improve upon the contemporary remote sensing methods developed in our previous research, which mapped and monitored mangroves on a periodic basis (i.e., every 5–10 years). These previous studies generated data on the distribution, density, and species composition of mangrove forests from local to global scales. Landsat data are available and suitable for the annual analysis in this study. We will use high resolution satellite data such as GeoEye and WorldView (available from the National Geospatial Agency, restricted use) for training and validation purposes. Other ancillary data such as SRTM 30 m DEM and forest inventory data will also be used. Our aim is to generate information on deforestation (i.e., mangroves converted to other land uses), degradation (i.e., mangroves remain but have reduced density), and regrowth. The contractor shall also contribute to develop and test methodology for annual monitoring, perform annual mangrove cover change analysis, and estimate carbon stock change.

We have developed and tested a fully automated new algorithm called MapPy to pre-process annual Landsat data, including unzipping, stacking, radiometric correction, atmospheric correction, cloud and haze removal, gap filling (Landsat 7), subsetting, and mosaicking. MapPy is a Python library for image processing, feature extraction, and classification. It depends on various third-party packages and modules (e.g., NumPy, GDAL). If a cloud-free pixel from Landsat observations is not available for an entire year, it uses clear pixels from either the previous or a preceding year (annual mosaicking does not impact evergreen mangrove forest discrimination). MapPy uses tidal information to identify data for low-tide and high-tide periods. The subsetting step involves selecting areas where mangroves are likely to occur and excluding areas where they are not found (i.e., far inland, highlands, and open ocean). Subsetting reduces data volume and increases overall mangrove classification accuracy by reducing the spectral variation imposed by other land cover types.

We will use three different techniques to classify the annual mosaic from 1985 to the present: Random Forest (RF) classifier, Continuous Change Detection and Classification (CCDC) (Zhu and Woodcock 2014, and Change Vector Analysis – Decision Tree Classification (CVA-DTC). **RF classifier** is an ensemble classifier that produces multiple decision trees using a randomly selected subset of training samples and variables. This classifier has become popular within the remote sensing community due to the accuracy of its classifications. It is well-described in many publications. We will use the RF classification algorithm to classify mangrove cover annually from 1985 to the present, followed by the application of an annual temporal filter to remove illogical land-cover transitions. **CCDC** is a new algorithm (based on data-driven thresholds derived from all Landsat bands). Land cover change is identified once the difference between observed and predicted reflectance values exceeds the threshold three consecutive times. The land-cover change information is used to derive a land cover map. **CVA-DTC** is a new Landsat-based change analysis method. It includes image pre-processing, image normalization, calculation of change vectors, and segregation of change vectors to determine areas of change and no-change, training data sampling, land cover classification, and post-classification editing (Fig. 2).

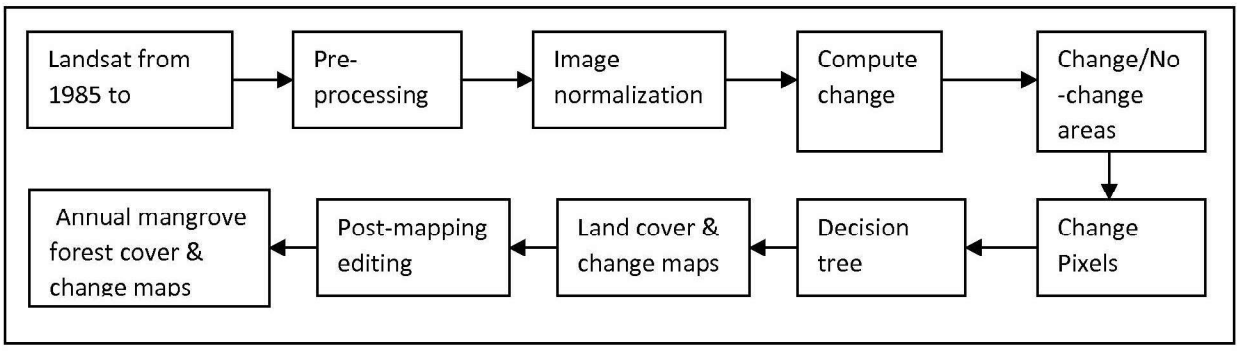

Figure 2: Flow-chart of Change Vector Analysis – Decision Tree Classification (CVA-DTC), one of the three techniques we will use to classify the annual mosaic.

The main goal is to characterize and summarize mangrove forest dynamics over time based upon the observed temporal trajectory of a spectral variable. We will also use a host of indices (e.g., NDVI) calculated from different algebraic manipulations of the original spectral bands and their

derivatives. Our work will demonstrate and verify the utility of disturbance and recovery metrics derived from annual Landsat time series mosaics for classifying annual mangrove cover.

Comparisons of the three classification approaches shall be performed using interpreted high resolution (<5 m resolution) satellite data for four sites: the Indus Delta (Pakistan), Goa (India), the Irrawaddy Delta (Myanmar), and the Sundarbans (Bangladesh and India). We will conduct in-depth field surveys at the same sites. We selected these sites based on our prior studies (e.g., in the Indus Delta (Fig. 2)) and the involvement of local collaborators. The surveys will record spatial information on such features as presence and absence of mangrove forest cover, species composition, and density using GPS. Historical information on the distribution and dynamics of mangrove forests at these sites will be collected from local authorities.

Published data and literature will be used to evaluate performance of the algorithms in other areas. In particular, we will use the mangrove data generated by Giri et al. A two-step validation approach will be adopted: qualitative and quantitative. As a qualitative check, we will divide the entire area into 500 x 500 m regularly spaced grids and check each grid visually to identify and correct any gross errors inherent in the classification maps. Next, we will generate an error matrix (overall accuracy, users and producers accuracies, kappa coefficient, etc.) for the 2017 classification using an interpretation database prepared using very high resolution imagery. Stratified random sampling will be used to generate and interpret 500 sample points each for mangrove and non-mangrove areas. Visual interpretation will be performed. This will be supplemented by our high-resolution interpretation of the four sites, mentioned earlier.

The most accurate classification results will be used for further analysis, including annual mangrove change analysis to identify the rates, patterns, and causes of mangrove cover conversion, disturbance, and regrowth.

INSTRUMENTATION/EQUIPMENT EXPECTATIONS

High end desktop computer with commercial software such as ERDAS Imagine will be provided to the contractor. No instruments or equipment are expected from the contractor.

QUALITY ASSURANCE

A quality assurance project plan (QAPP) to cover the work to be conducted for this project will be revised and provided by EPA. The revision will be completed within 30 days of the contract being awarded. The contractor shall follow the QAPP as supplied by the EPA WACOR that is titled "Quality Assurance Project Plan - Remote Sensing of Mangroves" (QAPP ID: D-EMMD-0031555-QP-1-1).

DELIVERABLES

Major deliverables include (i) mangrove database of select countries (number of countries and geographic scope will be provided through technical directions); (ii) Identify gap in world coverage and complete the mangrove/non-mangrove classification; (iii) visit in mangrove forests in Puerto Rico (5 days) and Everglades National Park, Florida (3 days); (iv) Provide input toward preparing a comprehensive database of mangrove cover change (deforestation and other

disturbance, regrowth, recovery) on an annual basis from 1985 to the present (initial focus will be South Asia and Puerto Rico); and (v) Contribute in preparing a change analysis database.

SCHEDULE OF DELIVERABLES

NOTE: All projected deliverable dates outside the performance period of this WA (i.e., ending March 31, 2020) are only forecasted projections if work were to continue on this project through a future contract vehicle.

Major deliverables	2020	2021	2022
Complete mapping of mangroves in select countries of the world	X		
Identify gap in world coverage and complete the mangrove/non-mangrove classification	X		
Conduct field visit in Puerto Rico and Everglades, Florida, and attend a conference	X		
Complete annual database from 1985 to the present on mangrove cover change (deforestation and other disturbance, regrowth, recovery) and change analysis	X	X	
Change analysis database – Initial focus will be South Asia and Puerto Rico.	X	X	X

EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 4-127

☐ Other ☐ Amendment Number:

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-15-008	04/01/2015 To 03/31/2020 Base Option Period Number 4	See attached PWS

Contractor: JACOBS TECHNOLOGY INC.

Specify Section and paragraph of Contract SOW: Section 2.0

Purpose:
- [X] Work Assignment
- [ ] Work Assignment Amendment
- [ ] Work Plan Approval
- [ ] Work Assignment Close-Out
- [ ] Incremental Funding

Period of Performance: From 04/01/2019 To 03/31/2020

Comments:
Work Plan is due within 20 calendar days.

Work may begin immediately.

☐ Superfund — Accounting and Appropriations Data — [X] Non-Superfund

SFO (Max 2): ☐

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code
1										
2										
3										
4										
5										

Authorized Work Assignment Ceiling

Contract Period:	Cost/Fee:	LOE:
04/01/2015 To 03/31/2020		
This Action:		
Total:		

Work Plan / Cost Estimate Approvals

Contractor WP Dated:	Cost/Fee	LOE:
Cumulative Approved:	Cost/Fee	LOE:

Work Assignment Manager Name: Daniel Vallero (Signature) (Date)	Branch/Mail Code: Phone Number: 919-541-3306 FAX Number:
Project Officer Name: Robin S. Harris (Signature) (Date)	Branch/Mail Code: Phone Number: 919-541-0955 FAX Number:
Other Agency Official Name (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:
Contracting Official Name: Keith Pfeffer (Signature) (Date)	Branch/Mail Code: Phone Number: FAX Number:

Performance Work Statement

WA Title: Refinement of Analytical Preparation Methods for Asbestos in Soil

WA #: 4-127		WACOR:	Daniel A. Vallero
Contract #: EP-C-15-008		Alternate WACOR:	Peter P. Egeghy

PERIOD OF PERFORMANCE

The period of performance detailed in this Performance Work Statement (PWS) shall be from the time of Work Assignment issuance through March 31, 2020.

SUMMARY OF OBJECTIVES

Soils contaminated by asbestos are highly variable. As a result, the ability to use soil data in human health risk assessments has been limited. Variability in soil measurements has led to limitations in comparing results from sites nationally and difficulties in reproducing results, even from the same sites over time.

To address this gap, this project will refine and standardize asbestos soil sampling, sample preparation, and analytical techniques to provide a consistent methodology that can be applied to a wide range of asbestos-contaminated sites from different parts of the country. This will be done by taking samples from specific asbestos-contaminated sites with varying soil types and fiber concentrations using incremental sampling methodology (ISM). The study will determine the sensitivity of various analytical methods; differences in measurement results from different locations, and comparisons of correlations of activity-based sampling (ABS) results with the soil analytical results.

Specific objectives of the project are:

Objective 1: Collect soils using ISM at sites with naturally occurring asbestos and building materials that contain asbestos.

Objective 2: Prepare soils for routine analysis in a consistent fashion in attempt to improve reproducibility of measurements. Conduct soil analyses.

Objective 3: Perform statistical analysis of the data to determine if reproducibility improved over previous studies.

TECHNICAL APPROACH

The U.S. Environmental Protection Agency (EPA)'s Office of Land and Emergency Management (OLEM) currently recommends the rigorous process of activity-based sampling (ABS) to characterize site exposures. EPA's aim is to identify a soil method that can be used to screen sites contaminated with asbestos instead of relying on ABS. This project will continue to enhance the soil methods recently developed under the RARE project. EPA scientists will provide guidance sample collection, handling, staging and preparation methods for soils sampling and analysis. This will refine EPA's soil sampling and sample preparation methods to

achieve more consistent results for samples collected from a variety of asbestos-contaminated sites from different parts of the country. Metals will be used as a "positive control" because in a previous project (Wroble et al 2017), consistency among metals results show that improvements to sampling and sample preparation techniques demonstrated that variability in the underlying soil matrix had been adequately controlled for metals. For the current work assignment, performance evaluation standards will not be addressed, but we hope to assess these in a future, related project.

Soil samples from up to seven asbestos-contaminated sites shall be collected using incremental sampling methodology (ISM). Five replicate samples of 100 increments each shall be collected from each location. By using 5 replicates instead of triplicates (minimum recommendation of most ISM protocols), statistical power may be increased. By using 100 increments (versus 30 used in the previous study), it may be possible to overcome the heterogeneity inherent in determining asbestos concentrations in soil. The selected sites shall achieve a variety of soil types, asbestos source materials, and asbestos types. All of the soil samples shall be processed at a single location (e.g., RTP) to minimize differences in handling, soil preparation, and sample preparation. At this central location, activity-based sampling (ABS) shall also be conducted to quantify the release of asbestos fibers from soil samples during aggressive disturbance. Prepared samples shall be submitted to a contract laboratory for routine asbestos analysis by PLM, PLM followed by TEM, and FBAS preparation followed by TEM.

The results shall be analyzed statistically to answer four questions:

- Are some analytical methods significantly more sensitive than others?
- Do different analytical methods produce significantly different results?
- Does one soil asbestos method result in more reproducible results than the others?
- Is there a significant correlation between ABS measurements and the soil analytical results?

Research Results and Products:

Several regions are participating in this project by providing access to sites contaminated with asbestos or providing staff to participate in the project. Regional managers would like to have a faster and more cost-effective option than ABS to determine that asbestos-contaminated sites do not pose a risk to human health. To date, EPA staff are not confident that the available soil methods for asbestos provide reproducible results. Further, several of these methods are not sensitive enough to detect asbestos at levels where the risk is considered negligible. An improved soil characterization approach that includes incremental sampling of soils; rigorous preparation, homogenization, and subsampling of soils; and analysis is expected to provide more reproducible data and the basis for more defensible decisions at sites. At the Libby Asbestos Superfund site (EPA Region 8), the FBAS was used to assess background concentrations of amphibole fibers in soils surrounding Libby and Troy, MT.

It was also used to compare mineral fiber concentrations and type between the Libby site and distant locations in Whitefish, Eureka, and Helena, MT. At a Region 4 removal site, one of the proposed methods (FBASA followed by transmission electron microscopy) was used to screen out sites that will not be remediated. This decision was supported by research conducted by EPA in 2013 using performance evaluation samples (Januch et al 2013), so there is some confidence that the levels of asbestos in soil and sufficient low that any risks would be negligible. EPA desires to strengthen support for this approach at sites nationally. EPA expecs to submit a paper for publication to a peer-reviewed journal and also to present the findings at technical meetings, such as the ASTM Johnson Conference on Asbestos or Society of Toxicology Meeting. The results of this research project may ultimately be folded into EPA's Framework for Investigating Asbestos-Contaminated Superfund Sites to provide an improved recommended approach for sampling soils with asbestos. Further, if a suitable soil method is identified, then ABS may be no longer needed to declare sites "clean."

The target audience consists of internal staff such as regional risk assessors, project managers, and on-scene coordinators who need better sampling and analytical approaches for assessing asbestos in soils at cleanup sites. EPA has also provided training to state, local, and tribal environmental staff who were interested in learning more about assessment of asbestos contaminated sites. Results of this research will be shared with these partners especially as it impacts sites under their jurisdiction.

EPA expects to provide more credible scientific underpinning to Regional, state, and other Respirable Elongated Mineral Particles (REMP) researchers in how best to sample soils contaminated with asbestos and other elongated mineral particles. Ideally, the recommended approach would provide a means of exiting the "framework" without performing ABS. However, there must be a high degree of confidence in the data to make that recommendation.

QUALITY ASSURANCE

The Contractor shall use the existing EPA-approved Category B QAPP, "Regional Methods Project: Comparison of Soil Sampling Methods for Asbestos at the Sumas Mountain Asbestos Site, Whatcom County". The WACOR will include additional project personnel and work assignment specific tasks.

Currently, Version 2.2 of this QAPP is being utilized; however, it is being updated for the current RARE project to support multi-Regional projects to evaluate and improve soil sampling methods for asbestos. Mainly, this will change some processing steps. When the new QAPP is approved, it will replace the above-listed QAPP.

DELIVERABLES

Deliverable	Delivery Schedule
Monthly progress calls and emails to include current results summaries	Ongoing during performance period
Fieldwork at seven sites	No later than March 31, 2020

R input data files	No later than March 31, 2020
Assistance in report and manuscript development, including text and figure development, for manuscript on sensitivity analysis of soil asbestos data in risk assessment	No later than March 31, 2020